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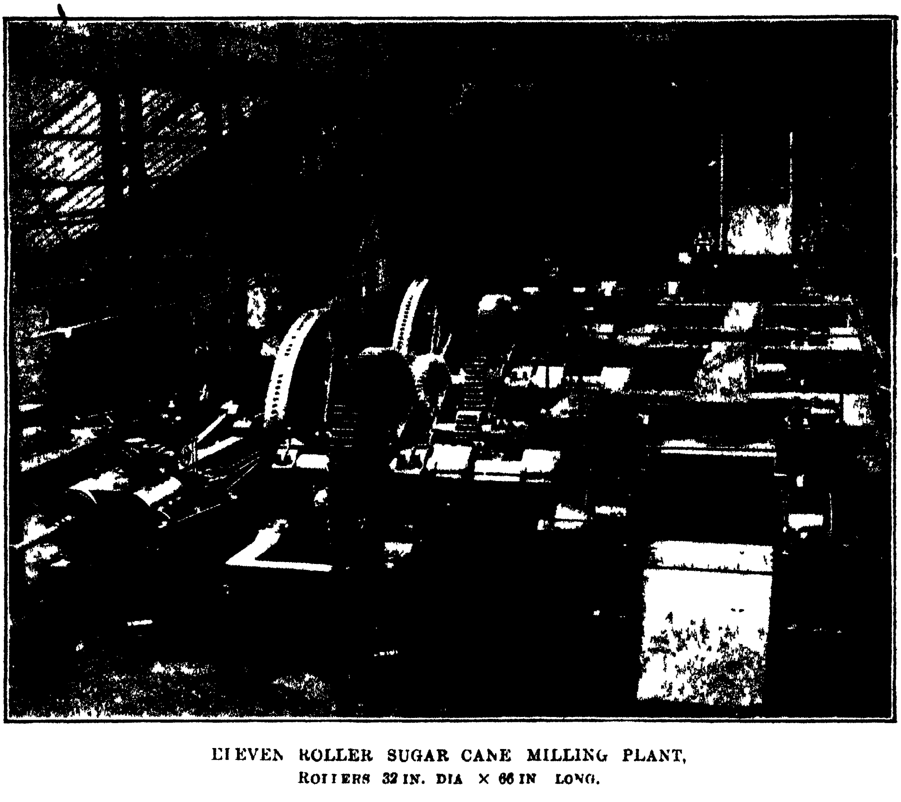

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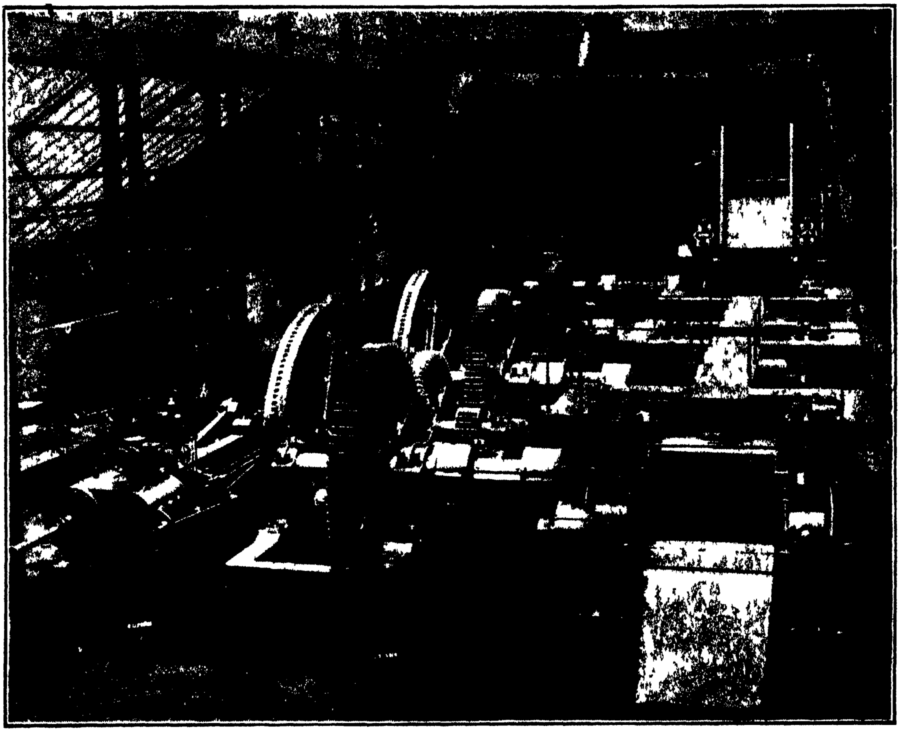

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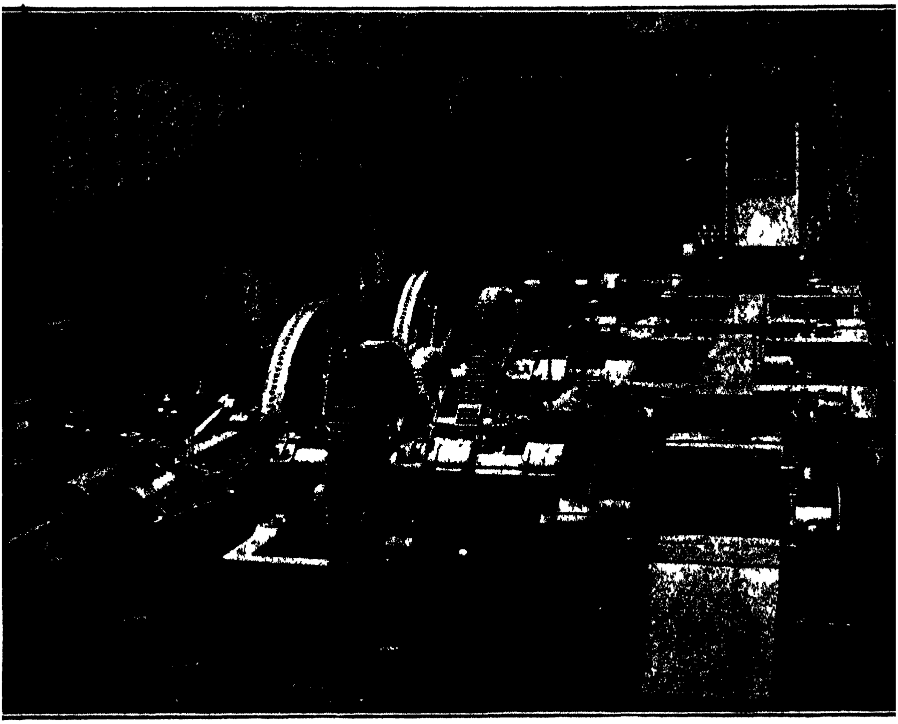

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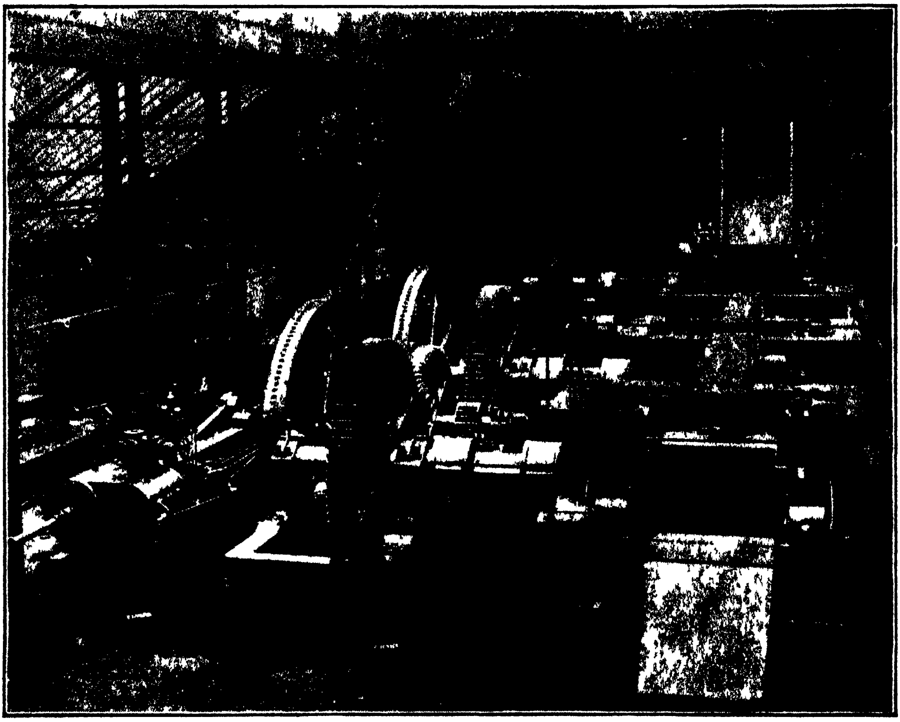

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Notes and Comments.

An American Beet Factory for England.

The most interesting news to chronicle this month is undoubtedly the fact that the contract for the erection of the new Peterborough beet sugar factory, which Capt. J. N. Mowbray and his associates on the board of the Central Sugar Co., Ltd. are promoting, has been let to the well-known American firm of beet factory engineers, Messrs. Dyer, of Cleveland, Ohio. This firm quoted the sum of £260,000, while the nearest British tender was £296,000. But the Dyer Co. are not providing the machinery, which will nearly all be of British manufacture[1]; they will merely design and erect the factory and probably be responsible for running it. The last feature seems a likely contingency since it is reported that the Dyer Co. are taking up 80,000 shares in the Company, and will have one of their nominees on the board of directors.

We are glad to learn that an American designed and operated beet factory is to be erected in this country, since we have all along held the opinion and expressed it in these columns that with a view to getting the widest experience in beet factory *modus operandi* European practice should not be the sole one followed in our experimental factories. It remains to be seen, however, whether the Dyer Co. are having a free hand with the design, or whether as has been stated in Parliament the tenders were drawn up in conjunction with various foreign machinery manufacturers, and whether these happen to be continental and not American, and are such as to tie the contractors to certain arrangements.

Rapid Progress of Beet Factory Extensions.

Every month information appears in the home press of mooted new factories in fresh districts of this country. We have a record of at least 28 factories that are either erected or will in all probability be erected for the 1926-27 campaign. And there are others that may be classed as possible. Thus Scotland may not only have the Cupar factory now under construction, but the Anglo-Scottish Beet Sugar Corporation may erect two other factories in that country to serve the Forfar and Lothian districts. Then Ireland is starting its first factory in the Carlow district with the aid of Belgian and Czecho-Slovakian interests. As for the United Sugar Company's second factory at Selby, it is, like the first, to be erected by the Skoda Works, of Bohemia, and will be ready next season.

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[1] It is said to be a specific term of the contract that all but £20,000 of the cost is to be spent in this country.

In our last issue we referred to the probability of the severe weather of November and December interfering with the smooth working of our new factories, owing to the lack of experience in such cases of our farmers. This is what appears to have happened with regard to Kelham which closed down prematurely when 12,000 tons of roots short of its crop. To save expense, it was arranged that these when lifted should be transferred to Cantley factory for slicing, and so save Kelham from running wastefully. The farmers are accused of having delayed operations in expectation of a mild winter and so were behind time with their deliveries even before the frost put a temporary end to lifting operations. The farmers' reply is that the season was late, that the factory opened a month too early, and that the sugar content in October was not high enough to warrant a start being then made. Whatever the real facts be, the point is apparent that factory supply cannot be learnt in one or two seasons, and the recent unusually severe weather will have served a useful purpose in impressing on British beet farmers that they must give foremost attention to the expeditious delivery of the roots they have contracted to supply if the factory is to be in a position to work profitably.

The British Empire Sugar Research Association.

In 1917 a movement was begun to establish, with the assistance of the Government Department of Industrial and Scientific Research, an Empire scheme for the scientific investigation of the problems arising in the British sugar industry, and to encourage and improve the technical education of persons who were or might be engaged in the industry. A Research chemist was appointed in the person of Mr. R. G. W. FARNELL, A.I.C., A.R.C.S., and by means of subscriptions from interested parties, *plus* a £ for £ grant by the Government Department, sufficient funds were obtained to finance the Association for an agreed term of five years from the start. This period ended with the close of 1925, and the Association are now faced with the problem of finding a minimum of £2500 a year from the industry if the Government grant is to be continued on the same *pro rata* scale.

At the same time, it is apparent that the beet sugar industry at home is in need of providing a Research Association to cover its own interests, and there seems no reason whatever why the two bodies, the older cane sugar association and the contemplated beet sugar one, should not combine to form one association, in which event the cost to each of providing from their members the sum laid down by the Government, as the minimum for a Research Association receiving Government assistance to the like amount, would be materially reduced. In other words, the £2500 stipulated by the Government regulations would come, partly from the cane sugar interests, and partly from the home beet industry; and the chances of each party securing its agreed proportion would be accordingly lightened. There is every reason why the two branches of the Empire sugar industry should co-operate in this matter to their mutual benefit. But the British beet industry is not yet sufficiently advanced to undertake research work, though it should be in a position to do so by the end of this year. Similarly, the Empire sugar producers associated in the British Empire Producers' Organization, covering every important sugar-producing Association in the Empire, are contemplating the formation of a strong Empire Sugar Federation which when formed will, it is hoped, support research work adequately. Pending the settlement of these matters, it seems that the present Research Association will have to suspend its action for lack of funds, but it is strongly to be hoped that this will only be for a short period.

It may be mentioned here that the research work carried out by Mr. FARNELL the last few years has been briefly as follows: First he undertook investigation to determine what were the colloids responsible for clarification difficulties, then he examined their existing methods of manufacture to ascertain their relative efficiencies in removing these substances. More recently he has been attempting to improve the existing methods by studying the optimum conditions of formation of the granular inorganic precipitates (calcium phosphate, calcium sulphite, and possibly calcium carbonate) owing to which the defecation, sulphitation and carbonation processes exert their clarifying action on cane juice. This work is fundamental and affects producer (both cane and beet) and refiner. Later on there is scope for embarking on a study of active carbons and their optimum conditions of application. But, as mentioned above, this is contingent on the Association being able to develop on the lines which we have indicated.

The Sugar Position in the United States.

In a survey of the financial conditions in the United States the Guarantee Trust Company, of New York, in their monthly review, dealt recently with the sugar situation. We cull the following points from their summary:—

The weakness in sugar prices during the last two years reflects a situation similar in its essential features to the depression in American agriculture from 1920 to 1924. The situation is aggravated, however, by the tardy adjustment of production to demand, which is due to the peculiar economic characteristics of the sugar industry. It is a natural aftermath of war-time disruption; and in view of the extraordinary degree to which the world's sugar situation was affected by the war, the slowness of the recovery is not surprising.

Raw sugar is now selling in New York at about 4 cents per lb. The decline since the beginning of 1925 has been slow, but almost uninterrupted. There has been a general downward trend since the spring of 1923. The latter date marked the peak of the upward movement following the tremendous post-war slump, which carried prices from 21 cents a lb. in May, 1920, to about 3½ cents in January, 1922. The present price, therefore, is not much higher than that which prevailed four years ago. That it is distinctly out of line with commodity prices in general is evidenced by the fact that it is almost exactly equal to the five-year pre-war average, and is generally agreed to be below the average cost of production. This low price is clearly due entirely to over-production; there is no evidence of curtailed demand; on the contrary, consumption throughout the world is gradually increasing. But the world's supply for the time being has completely outstripped its consuming capacity.

The reasons for this are not difficult to discover. Although the sugar crop of Europe, even with its recent rapid recovery, has not reached its pre-war level, the deficit has been much more than made up by a persistent increase in the crops of Cuba, Java, and other sugar-exporting countries. The last Cuban crop was 37 per cent. larger than five years ago. Production in Java is 48 per cent. larger, while the crops of Brazil, Hawaii, Porto Rico, the Philippines, and other regions have greatly increased, In the United States the production of both types of sugar fluctuates widely from year to year. Last year the cane sugar crop was only 79,000 tons, a phenomenally low figure, while the output of beet sugar was very large, amounting to 974,000 tons.

Apart from American interests in the Cuban sugar industry, the United States has a direct interest in other markets for the Cuban crop, especially in Europe, where the facilities for refining cane sugar are somewhat limited. During the war, when Europe became suddenly dependent upon the Cuban output, American refiners were called upon to remedy this deficiency. For the time being the States became one of the world's principal exporters; and from about 85,000 tons average in the years 1911 to 1915, their exports in 1916 to 1920 increased in average to 540,000 tons. As late as 1922 they reached a total of nearly 920,000 tons; but for the year ended June 30th last, the amount had fallen to about 250,000 tons.

This swift decline in exports of sugar does not, of course, indicate a corresponding decrease in the activity of American domestic refiners, since the large shipments of the war years were made possible by a severe curtailment of consumption in the U.S.A. Moreover, the use of sugar has increased very rapidly in the last few years in the States. The peak of activity in the American refining industry was reached not during the war, but in 1922 when consumption was free from war-time restrictions and the foreign demand was still very strong. Raw sugar melted by domestic refiners in the first ten months of 1925 amounted to 2,880,000 tons, as compared with 3,250,000 tons in the corresponding period of 1922. In a lesser degree the present situation works to the disadvantage of American producers of sugar cane and beet, for the price differential between domestic and imported sugar is necessarily limited. But with the protection afforded by the import duties, the position of the producers and refiners of domestic sugar appears more favourable than that of the seaboard refiners who are directly affected by the loss of foreign markets.

It is probable, says our contemporary, that no fundamental change will show itself for another year at least. Estimates of production for the coming season indicate that a further increase in the world's output is likely. Cuba will have slightly more, and so will Java. The largest gain, however, is expected in Europe, in spite of the fact that France, Belgium, Holland, Italy, and Spain are likely to have a decreased output. The Russian output is placed at 950,000 tons or more than twice the amount of the 1924-25 crop (but we must observe, parenthetically, that reports of Russian crops are so unreliable that little weight can be attached to such estimates). The decline in output that must precede any sustained price recovery will probably be effected at the expense of producers in Cuba and other large exporting countries. It has for many years been a fixed policy with most nations to protect and foster their domestic sugar industries, relying on foreign supplies only for the balance of their requirements. The American market for Cuban sugar is, of course, secure. But it may be very difficult to hold permanently any large share of the war-time European markets.

Will Consumption overtake Production?

The view held by the above-mentioned financial house that a decline in production is a *sine quâ non* to a price recovery appears to us, however, to ignore the possibilities of further expansion of the consumption with the return of the world to more normal conditions. It is quite possible that the remarkable increase in consumption which has characterized the 1924-25 season as compared with that of 1923-24 may be repeated in 1925-26, even if only on a smaller scale. Some data we give on another page, compiled from Belgian sources, show that while the world's supplies last season were about 3½ million long tons in excess of the previous campaign, the consumption increased by well over 2½ millions, so that stocks were only 717,000 tons larger at the end of August. The present crop suggests an increase of about 832,000 tons only, so it does not seem impossible that the excess may be wiped out by a reasonable increase in the consumption. Certainly the outlook is not one to be pessimistic about.

Consumption in the United Kingdom is increasing steadily if not specially rapidly; for the year 1925 the total, as gleaned from the Board of Trade figures, came to 1,662,982 tons, as compared with 1,563,138 tons in 1924, 1,470,213 tons in 1923, and 1,604,532 tons in 1922. This is the largest consumption since 1914, which it nearly equals, and has only been otherwise exceeded by 1913 which was about 1,731,900 tons. Moreover the pre-war consumption of the United Kingdom included the whole of Ireland, whereas nowadays the sugar consumption of the Irish Free State is not included in the Board of Trade figures for the United Kingdom.

The Trend of Cuban Prices during 1925.

Messrs. WILLETT & GRAY recently published in their weekly Sugar Trade Journal a chart of Cuban Centrifugal Sugar prices for the period January 1st to December 9th. The figures were c. and f. to New York, basis 96°, and of course relate to the 1924-25 crop. On January 5th the price was 3 cents per lb. ; then till February 25th it fluctuated between 2·75 and 2·87, thereafter rising slightly till on March 7th it topped the chart for the year with a price of 3·06. This was followed by a steady fall culminating on May 12th with 2·50. Thence till August 28th the price fluctuated between 2·47 and 2·69. From September 1st another steady fall took place which was not permanently arrested till October 27th, at which date the price was as low as 1·94 cents. Thereafter a sharp rise occurred which reached 2·44 cents by November 13th, and from that date till December 9th the limits of variation were 2·50 and 2·25 cents, at which last figure the price stood on December 9th.

Messrs. WILLETT & GRAY remark that the chart[1] shows almost at a glance the opinion of the Trade during the year regarding the size of the 1924-25 Cuban crop. For the first three months this crop was expected to outturn about the size of the preliminary estimates, but about the middle of March many interested in sugar formed the opinion that early estimates would be materially exceeded, and this caused the sharp decline recorded between early March and the end of April. At the beginning of September opinion was unanimous that the crop would exceed five million tons instead of the earlier estimates of 4¼ to 4¾ million tons, thus suggesting a rather heavy carry-over of Cubans at the end of the year ; and this caused a sharp decline to what proved to be the lowest point of the year, viz., 1·94 cents. But the decline was somewhat overdone, and an upward trend followed which continued till the approach of the new crop began to influence prices. On December 10th a sale of new crop Cubans was made at 2·25 cents for the latter half of December shipment.

Work at the Hawaiian Sugar Experiment Station.

The Reports of the Committee in charge of the Experiment Station of the Hawaiian Sugar Planters' Association, for the years 1924 and 1925, have reached us in such close proximity that they have been considered together. There is, however, such a wealth of interesting matter in the detailed reports of the officers in charge of the various heads of work, that we have been obliged to confine ourselves at present to the summaries presented by the Director. In these we are glad to note the usual and characteristic tone of optimism, possibly fortified during the past year by Mr AGEE's visits to the cane fields of the West Indies and

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[1] Copies of this Chart specially printed for framing can be obtained from Messrs. WILLETT & GRAY, 82, Wall Street, New York, for $1 per copy post free.

Louisiana ; and, if so, he would appear to be fully justified by what follows. In the submittal report of the Committee it is stated that the total cost of the Station in 1925 was very considerably greater than in the previous year and therefore, presumably, than in any previous year. The chief expense of the year was, doubtless, in the completion and equipment of the new building for housing the sugar technology department, the total cost of which was over $70,000. It is evident that the planters of Hawaii fully appreciate the benefits to be derived from the intensive scientific study of the sugar cane industry in all its phases.

The Director remarks that, in 1925, the Station reached its 30th year, and that this year also showed the greatest crop of sugar ever obtained in the islands. Good management, good weather and adequate labour have conduced to this result, aided, however, by numerous "technical considerations." The following is the list of these, according to Mr. AGEE : Greater areas under H 109, D 1135 and Yellow Tip varieties ; better control of leaf hopper, mosaic and field rats ; greater care in seed selection ; maturing the canes by withholding irrigation water towards harvest time ; an increase in nitrogenous manures and, where found necessary, of potash and phosphates ; earlier application of fertilizers in the second season ; increased rapidity in getting cut canes to the mill ; the omission of cutting back in July, and the subordination of hilling up and off-barring to the problem of weed control ; a closer co-ordination of field practices so as to realize their interaction to the best advantage ; and the steady progress made in improving the methods in the factory, and in chemical control. When we consider that many of these factors have been evolved as the result of intensive study referred to in previous reports, we recognize that the work of the Station has the full approval of the body of planters in general, and that they are willing to follow the advice given from time to time. They must regard this Institution, which is completely under their control, as a valuable asset in the sugar production of the territory.

In this connexion we have to record our peculiar pleasure in meeting Mr. AGEE during his very brief visit to this country. It is one of the handicaps of an English journal dealing with tropical products that its editorial staff is precluded from visiting the crops themselves, and in discussing matters on the spot with the planters or those engaged in experimental work ; and, although some of our staff are well acquainted with the growing of sugar cane and factory work in different countries, it is physically impossible for such a wide area as is occupied by the sugar cane to be satisfactorily covered by one individual. The personal touch thus becomes important, and we welcome the many visits we receive from overseas correspondents every year.

The Financing of the Philippine Sugar Centrals.

In the presidential speech made at the third annual convention of the Philippine Sugar Association held in Manila last October, reference was made to the financing of the "bank" centrals and their prospects. These centrals were started by means of Government help financed through the Philippine National Bank. In October 1922, the centrals were indebted to this bank for a total of 42 million dollars ;[1] and at that date their combined capacity was some 6000 tons daily. A year later the indebtedness had been reduced by $2,600,000, but further obligations were incurred to cover machinery and railway lines, which raised the debt to $41,000,000. However the advantages of these extensions can be judged by the fact that the combined capacity of the centrals at October, 1924, was

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[1] The dollars given in this *Note and Comment* are in every case Philippine dollars equal to 2s. 1d. at par value.

9600 tons per day, an increase of over 50 per cent. The capital (including the loans) invested in the six centrals amounts to the sum of 4,800,000 Philippine dollars, giving an average of $267 per ton of production, while in Hawaii the average is said to be as high as $450.

According to Mr. R. R. ALUNAN, the President, the sugar production of the Philippines for the 1924-1925 crop is about 535,000 metric tons, of which 458,000 consist of centrifugal sugar. With a total capital investment of at least $319,000,000 and an export crop whose value this year is estimated at $80,000,000, sugar is now the leading industry of the islands. Mr. ALUNAN is optimistic enough to think the centrals will in time be a success,, and benefit not only the sugar people and the banks, but also the whole country.

Recent Company Reports.

Sena Sugar Estates: The directors of the Sena Sugar Estates Ltd., in their report for the year 1925 state that the output of cane sugar was 39,018 tons, the highest figure reached in the history of the Company so far. Of this amount the older factories of Mopea, Caia and Marromeu produced 35,029 tons, the balance being from the new factory of Luabo. The average price realized for the sugar was just over £17 per ton as compared with almost £23 in 1924. But in view of the fall in the price of sugar during the time the crop was sold, this price must be considered as satisfactory. Profits amounted to £207,335, as compared with £253,020 in 1923. No dividend, however, was recommended because in the Spring of 1925 an unusually prolonged flood visited the Zambesi Valley, due to heavy rains in Rhodesia, and flooded the country all round the Sena factories. The staff at Mopea were confined to their houses for no less than 57 days owing to the depth of the flood, and considerable hardship was experienced. As the result of the inundations half the growing crop of cane was lost and the total crop for 1925 is not expected to exceed 22,710 tons. In consequence, the directors felt bound to reserve their funds and were placing £50,000 to reserve, £30,000 to depreciation reserve, and carrying forward the balance of £157,384. This compares with 1923 when a dividend of 15 per cent. was paid. The Company, however, take a cheerful view of the future. They have four factories capable of producing 50,000 tons of sugar, and they have recently acquired a second sugar refinery in Lisbon, by buying out one of their principal competitors there. It is not proposed to spend any more money of a substantial amount on capital account, and their authorized share capital is now all issued.

St. Madeleine Sugar Co.: The report of the St. Madeleine Sugar Co., Ltd., for the year ending June, 1925, stated that 23,520 tons of sugar was turned out, the highest since 1917, but owing to the severe fall in prices the profit of the year after payment of debenture interest came to only £3748, which has been carried to profit and loss account, the deficiency on which account is now still £65,233. This would have been even worse but for the restoration of Imperial Preference to the rate at which it stood prior to 1924; and it may be noted that the accounts were charged with a sum for Corporation Profits Tax for 1924, an item that should disappear in future accounts. The Company has sold several coconut estates in its possession and has thereby been enabled to reduce its liability for debentures and mortgages from £100,000 to £47,054. Unfortunately for the immediate prospects the froghopper pest has attacked the growing crop, though the fields of the Company are less seriously affected than some other estates in the island. The chairman, in the course of his annual speech, described the tariff preference as of vital importance, and was confident that it would make all the difference in the world to them, as it would enable them to make a fair profit even when foreign sugar producers were working at a loss.

Fifty Years Ago.

From the "Sugar Cane," January, 1876.

In this issue of our predecessor there were no articles of a technical nature, space being given almost entirely to discussion of the foreign bounty system, which was occupying considerable attention at that time. Under the heading of "Monthly List of Patents," however, there were noticed several specifications.

L. Marot, in No. 408 of 1875, defecated saccharine liquids by adding at boiling temperature a solution of an alkaline earth, as lime or baryta, and also an alkali, as soda or potash or ammonia, free preferably from carbonates, the precipitate produced being filtered off.

J. B. J. Mignon and S. H. Rouart, in No. 973 of 1875, passed the cane through a rolling mill provided with two adjustable rolls and with an adjustable knife, the edge of which is set parallel to the axes of the rolls. These rolls were set so as to compress the cane into a uniformly and continuous sheet which was carried forward by the rolls to be separated into two sheets by the knife, later to be crushed as usual in a mill.

J. Duncan and B. E. R. Newlands, in No. 4107 of 1875, dealt with a modification of a patent previously communicated by M. Weinrich, No. 1870 of 1874. Partly refined sugar in a dry state was sifted and powdered, mixed with ultramarine blue to improve the colour, and placed in a centrifugal machine, where it was subjected to the action of low-pressure steam until the syrup running off was transparent. After drying and crushing, the sugar was ready for sale. As to the syrup, this was filtered through cloth and char, and after neutralizing its alkalinity it was boiled to grain and run into moulds, these being placed in centrifugals and washed with steam.

The same inventors, in No. 4264 of 1875, further improved their process by providing means for defecating the syrup obtained by the method of working just outlined. This consisted in adding to the syrup a solution of aluminium sulphate at ordinary temperatures, this being followed after agitating for about half-an-hour by calcium carbonate, or milk-of-lime, in quantity sufficient to render the whole neutral, or faintly acid. After heating, the product was filtered, and sent over char or boiled to grain directly.

T. Rowan took out a provisional patent, No. 4331 of 1875, of questionable validity, for a method of washing sugar in centrifugals, here described in the words of the abridged specification:—"Raw or impure sugar in the crushed or powdered state is placed in the basket of an ordinary centrifugal machine, and there acted upon while still in motion by a spray of hot or cold water, with or without admixture with alcohol or other spirit, or glycerin, the impurities thus being loosened and driven off from the sugar."

R. Blair and J. A. Turnbull, in No. 4227 of 1875, protected "means for accelerating the crystallizing of sugar from saccharine solutions. A quantity of crystallized sugar is added to the solution before or after being charged into the vacuum pan, after which the whole is mixed together. It is then rapidly boiled at a low temperature in order to produce large crystals."

The Home Sugar Trade during 1925.

Messrs. William Connal & Co.'s Annual Review.

Below we give extracts from the annual Report issued by Messrs. William Connal & Co., the well-known Glasgow sugar brokers, on the sugar trade during 1925. In part it relates to the Clyde sugar market.

Review of the home market:—America, with its intimate connexion with Cuba and St. Domingo, has continued to supply the principal wants of Western Europe with raw sugar, during the greater part of the past year.

Estimates of the 1925 Cuban crop were made in December, 1924, and were by Messrs. GUMA 4,724,714 tons, HIMELY 4,620,428 tons, and LAMBORN 4,500,000 tons, and when the year opened the quotations for Cubas were 13s. 9d. to 14s. 6d., c.i.f. At these limits, with few fluctuations, a steady market was maintained, and a large business done, both to the U.K. and Continent—for Holland more particularly—from January till the middle of April. Continental buying of cane sugars was scarcely to have been expected, with their local crops so great, but as the Continental production of raw beet had been greatly reduced, it was evident that raw cane was in considerable request, for supplying Northern Continental ports with refined sugar—Russia frequently entering the market as a buyer of white sugars on a large scale.

At the middle of April a sale was reported of from 180,000 to 200,000 tons of Australian sugar for shipment to U.K. during the last six months of the year. This large sale had a depressing effect, and it was realized that the demand for Cuban and Domingo sugars must of necessity be reduced during these months. The market became still further weakened by renewed estimates of the Cuban crop which then appeared, by which Mr. Guma's original estimate of 4,724,000 tons was raised to 4,925,000 tons, and shortly afterwards by Mr. HIMELY, whose original estimate of 4,621,000 tons was raised to 5,100,000 tons. A quiet and easier market was thereafter experienced, and at the end of April the quotation for Cubas had dropped to 13s. 1½d. a 12s. 9d., c.i.f.

The annual Budget was due, as usual, at the end of April, and although no change in sugar duties was looked for, yet there was the expectation that the preference of 4s. 3d. on British West India and Colonial-grown sugar, which had been reduced by the Labour Government to 1s. 11d., might now be restored. A committee appointed by the previous BALDWIN Government had advocated this preference of 4s. 3d., and for a period of ten years. The budget of 28th April restored this preference and the period of ten years was agreed to, in the hope of attracting capital to the industry, which during that period would remain undisturbed. A good deal of speculative interest was raised in anticipation of the preference being restored, or not, and a large business was concluded in B.P.W.I. sugar at such prices as coincided with the views of buyers or sellers, at the time —thus sellers would occasionally accept an offer of 15s. 9d., c.i.f., the preference if any being for their account, and buyers occasionally paid 17s. 6d., c.i.f., by taking the risk of preference.

The restoration of the preference has to some extent altered the position of the British sugar refiner as to his supply of raw sugar. In addition to the 200,000 tons of Australian sugar, the Mauritius and Natal crops again became available for the U.K. market—and B.P.W.I. not required by Canada could always find a market in the U.K. at 3s. 6d. per cwt. above the Cuban quotation.

There was little animation in the market from May till July, the quotation and work in it was re-started a month ago. After the finish of the beet season it may be used for refining imported raws. Compared with last year, 14,796 tons less have been melted.

During January the market was dependent on foreign refined. When Greenock sugars became available in February fine granulated commanded 32s. 3d., and there was little variation in price till April, during which month prices sagged, and at the end the quotation was 30s. 3d. From then till the end of August fluctuations were unimportant, but the price had fallen to 29s. 6d. In September and October the fall was more pronounced, and the lowest price of the year was touched—25s. 9d.—ruling at the end of October. In November the market quickly recovered, when it was seen that the heavy European supplies were not being pressed for sale, and the price advanced to 27s. 6d. At the close of the year the quotation was 27s. 3d., duty paid.

Prices of foreign refined from the beginning of the year until the end of October showed a general decline of 5s. to 5s. 6d. At times there were firm periods, bringing in buyers who considered sugar to be at a moderate level, but these led to disappointment, and later to a general resolve to go on the hand-to-mouth policy. There was a recovery of about 1s. 6d. during the last two months of the year, and buyers were rather more confident in the stability of prices.

The opening price of fine Dutch was 18s. 6d., and of ordinary 18s., f.o.b., and in March the quotations rose to 19s. 6d. and 19s., with a gradual decline thereafter till October to 13s. 4½d. and 13s. 1½d. At the close the quotations were 15s. 1½d. and 14s. 6d., the latter, however, being a second-hand price. Dutch sugars were in steady demand throughout the year.

Czecho sugars started at 18s. 3d., f.o.b., and the extremes were 19s. and 12s. 7½d., the latter, however, being for November-December delivery, which was accepted at the end of October. December sugars ended at 14s. 6d. Last winter was a mild one, and Czechos were always available. A considerable business was done to the U.K. on to June, but thereafter a demand from Russia sprang up exhausting what was left of old crop sugars. A large business was done in November-December deliveries to the U.K., but most of the December lot is still ice-bound in the Elbe.

Belgian crystals were generally held for prices above the U.K. parity, and little was done in these descriptions.

Germany has not been an exporter this year, as she required all she produced for her own wants.

American and Canadian granulated came in in considerable quantities in spring and summer, gradually tapering off as the season advanced. Little came in after October, when Continental sugars took their place. The opening quotation was 19s. 3d., c.i.f., but this was above the parity of Continental sugars. Later on in January prices came more in line, and, as stated above, good business was done. The lowest price touched was 13s. 9d., but the latest prices quoted have been 15s. 6d. for Canadian December second-hand. The first-hand price of American, however, was understood to be about 16s. 6d., c.i.f.

The opening and highest and lowest prices were as follows for ready or prompt sugars :—

	s.	d.	s.	d.	s.	d.
Superior Dutch	18	6	19	6	13	4½
Czecho fine granulated	18	3	19	0	12	10½

Closing quotations were (30th Dec.) :—

Superior Dutch	15	1½	f.o.b.
Czecho fine granulated	14	6	,,

The Sugar Experiment Station in Hawaii.

The Record of 1924 and 1925.

The following summary of recent progress is drawn from the Reports of the last two years by Mr. A. P. AGEE, the Director; and deals as briefly as may be with the main projects at present engaging the attention of the large and competent staff as therein outlined.

(1) *Entomology.*—The Station appears to have commenced its intensive study of the insect pests of the sugar cane fields in 1903, and has scored some signal successes. Every sugar cane tract is invaded from time to time by enormous numbers of insects which, introduced casually from other countries, have been able to multiply because of the absence of their natural conditions and, especially, the enemies which serve to keep them in check. The balance of nature is disturbed, and the presence of large quantities of food for the invaders causes them to assume the character of a pest. Unfortunately the sugar cane affords an ideal feeding ground for insects, because, once established in the field, it is impossible to apply the ordinary direct methods for their destruction, on account of the luxuriant character of the growth of the canes. The attack has to be indirect, either by rendering the conditions unsuitable, or by tracing the unknown source from which the insects have come, and then searching for the enemies which have kept them from becoming conspicuous: such enemies may be parasitic or predatory, and are in most cases also insects themselves. This latter is of course a costly line of work, and cannot be freely undertaken in the majority of countries, especially where government aid has to be invoked : in such case the most that can be expected is the appointment of a chemist, botanist or entomologist, usually for all the crops grown. The great advantage of the project described is that, once the enemy of the pest has been discovered and introduced, the further stages of the experiment may be left to nature itself.

Quite possibly the Station was forced into this entomological work by the invasion of the cane fields by a *leaf hopper*, which increased to such an extent that the industry itself was threatened, in the early years of the present century ; for we read that in 1904 an egg parasite was introduced by PERKINS and KOEBELE, which in time reduced the hoppers so greatly as to eliminate them from the active list. More recently (MUIR 1920) another insect enemy was brought in, *Cyrtorhincus mundulus*, through whose additional activity it is now rather difficult to find the leaf hopper. In 1925 they "were scarcer than ever before." A similar tale is told of *Anomala*, a very different insect pest of the canes : a few are still to be found but, thanks to the introduction of *Scolia manilae* (MUIR 1913-1916), the control is entirely satisfactory.

At present the attention of the section is more especially devoted to the cane borer, the wire-worm, and the cane and corn aphids, the last-named being included because of its connexion with the spread of mosaic. The *Cane borer* is an ancient enemy of the sugar cane met with in all countries, although it varies in species from place to place. Less attention is generally paid to it than it deserves, because long experience has led to the view that it is inevitable, and the planter is satisfied if the destruction is no more than usual. Good work has been done in Hawaii by a tachinid fly (MUIR 1910), but control is nothing like as efficient as in the two cases already dealt with. Parasites from Mexico have not proved successful; but more recently a search in the Philippines and other Pacific islands has been rewarded by the discovery of another tachinid fly which has also been introduced (PEMBERTON 1925), though it is not yet possible to predict the result. And here the other line of work, that of rendering the conditions unsuitable, appears to be of some importance. Counts of the borers by the staff have shown that, with heavy winds on canes that tend to lodge (D 1135), the borer increases greatly, because the tachinid fly finds it difficult to penetrate the tangle, in its ceaseless hunt for the caterpillar. Later on in this review, the suggestion is elaborated that shorter crops are desirable in the islands, and this would tend to reduce the tangled masses of lodging canes.

The *Wire-worm* has as yet proved a more difficult problem. The search for natural enemies has been prosecuted for several years in the Philippines, Australia, and South America, but without success. Attention has been suggested to North America or Europe, but WILLIAMS believes that there is more likelihood of securing a parasitic wasp in the United States and South America, especially in the more tropical parts. The *Aphids* likewise are proving difficult. Although not a major pest, the cane aphis exacts its toll every year, and the corn aphis is important because of mosaic. Considering the number of projects before the Entomological section (and those mentioned by no means exhaust its interests) MUIR utters a warning note, and suggests concentration at first on the cane borer and the aphids.

Three other "pests" are mentioned as engaging attention : and, characteristically, although these are plants and not insects, they are being approached from the entomological point of view in Hawaii. These are the nutgrass, Lantana and Eupatorium. The latter is known locally as *pamakani*, and a report has been issued upon the insects attacking it ; but another year's study is required. As to *nut grass*, two insects have already been introduced from the Philippines, a weevil borer and a tortricid also boring : these have been noted as feeding exclusively on nut grass in the east. A disease on it has also been noted at Kohala, which it will be attempted to spread (this may be the red rust so often met with on nut grass in India). Further, the interesting fact has come to light that this plant is especially sensitive to large applications of sulphur to the soil. Anyone working in the tropics will be accustomed to the problem of dealing with these plant invasions, and many instances occur to the writer of this review. When all is said and done, it would appear to be more logical to apply ordinary cultural methods to these plant pests, and doubtless this is being done in the Hawaiian islands. But, in the present labour conditions, it may well be that any indirect methods, such as the introduction of natural enemies, will be of the greatest service.

In concluding this somewhat full treatment of insect pests, which occupy the pride of place in the Reports, the Director adverts to an important summary by SWEZEY of the work that has been done on the introduction and establishment of beneficial insects in Hawaii (not only by the Sugar Station of course). A list is given of over 100 successful cases, commencing with one by KOEBELE, in 1890, of a lady-beetle feeding on cottony scale. In this list are enumerated "19 lady-beetles feeding on scale insects and mealy bugs: 6 coccid parasites: 14 enemies of plant lice (including 10 lady-beetles): 8 enemies of the sugar cane leaf hopper : 6 Bruchid parasites : 7 fruit fly parasites, and 8 other enemies of Diptera : 7 parasites of leaf rollers and army worms : 12 of a miscellaneous nature and 8 enemies of the Lantana plant." A list is added of over 140 cases of foreign insects which have been introduced without successful establishment, as far as information is available; but this list is admittedly incomplete. In no case has any of the insect parasites in these lists become harmful to plant life in Hawaii.

(2) *Reafforestation.*—The sugar industry in Hawaii has reached a stage when irrigation is becoming more and more important. The rains are good, but vary greatly with locality, and the opening up of lands with a less supply needs much water. A great deal is lost every year by flowing into the sea, and there are two ways of preventing this, the first by engineering work and the second by forestry. Large sums of money have been spent on building dams and impounding the water from the streams so that it can be gradually led on to the fields, and in certain cases by erecting pumps to tap the underground supplies. The planting of forests is nature's method, and in consideration of the other ameliorations thus brought about, is perhaps the better in the long run. The rainfall is not, it is true, increased, but it is put to much greater use by this method: a gigantic sponge is laid over the areas of greatest fall, and the water is held up and only slowly, but continuously, given up to the lower lands. In the past all of the bare slopes in Hawaii were probably covered by luxuriant forests, but for many years these natural resources have been carelessly squandered: reafforestation is thus peculiarly the work of the sugar plantations.

The Station has been actively engaged in this since 1918, but it is slow work, and of course it is impossible to measure the success year by year. Large numbers of trees have been planted and many new kinds introduced: some of the latter will undoubtedly be of use on the water-sheds, while it is quite likely that some may be found of value in other directions besides that of water conservation. A great forest reserve has been established in the Hilo district, Hawaii, and this, and the small reserve at Kohala in the same island, offer useful examples of successful projects. A similar reserve is badly needed on the Koolau mountains in Oahu, as it is already felt that, with the increase of population of this island, water is bound to become an issue of the first importance. Co-operation has, however, been found to be much more difficult to arrange than in Hilo. But legislative action in 1925 has come to the rescue, and leaseholds of large areas used for ranching purposes have been acquired, thus removing one of the main obstacles for the project. Seven plantations have now agreed to co-operate, while one has withdrawn its support. In the other sugar islands, Maui and Kauai, afforestation is more in the hands of individual plantations, and projects have been already laid out.

(3) *Pathology.*—This section was reorganized in 1924, and work was started under LEE in January of that year. The nature of *Red Stripe disease* was investigated, and now that it is understood quarantine arrangements have been made to prevent its spreading to other localities: it is only severe on the Tip canes, and efforts are being made to obtain immune varieties by crossing them with D1135. With *Pahala Blight*, D 1135 has been found to be less troubled than other canes; but this disease has for many years resisted control, and even D 1135 suffers from it. McGEORGE has found that spreading flowers of sulphur on the soil in experimental plots shows good results. The treated plots remained free from the disease, and made twice the growth of those untreated. Grasses have been studied in connexion with *Mosaic*, and, as those most actively sought after by the corn aphis are known, an information campaign has been started. A survey has been commenced by LEE on the distribution of this disease, so that the planters may be kept informed as to the best sources for clean seed. *Chlorotic canes* have, as a result of work with pineapples, been treated with ferrous sulphate powder, and colour has thus been given to their leaves.

The study of *Lahaina disease* (also called root rot and root failure) continues, and is leading on to work of a more general character. In Maui the cause of the disease has been traced to unsuitable soil, and McGEORGE has made a special study as to the relative toxicity of various salts. Sodium chloride and aluminium salts have been found sufficiently harmful to interfere with the metabolism. Besides this, studies are being made as to the injuries caused by nematodes and centipedes to the roots, while the effects of bacteria and fungi, either of themselves or in connexion with these animal injuries are not being neglected. The whole problem is thus seen to be many-sided, and may in the first instance be approached by chemical treatment, and if that fails, by the substitution of other varieties. Thus H 109 has successfully replaced Lahaina in many places. The distress shown by D 1135 has been shown to be non-infectious, and to be due to aluminium toxicity. It is hoped that these studies will throw light on the question of the "playing out" of commercial varieties, and the necessity of replacing them by hardier kinds of cane. It is reassuring to read that, at present, the Lahaina disease is not causing much damage.

(4) *Seedlings and resistant varieties.*—It is satisfactory to learn that the closing down of Hawaii to the introduction of any canes from without is being relaxed. The wave of panic resulting from a clearer knowledge of the way in which numerous diseases have found their insidious way into various countries is now abating; and a greater degree of confidence is evident in various countries in the efficacy of well thought out quarantine schemes. That adopted by Hawaii appears to be without reproach, in that there is the double safeguard of all importations first passing through the Washington houses, and then under the careful supervision of the local experts. No scheme will prove to be immaculate, but in our present knowledge (of which perhaps we are unduly proud) all danger would appear to be removed for the country under consideration. The only warning that may be uttered is that the programme seems to be a bit hurried, and it is likely that more kinds are being introduced than can be properly studied and tested. In the following lists of importations there appears to be a little confusion, in that the same cane is mentioned as being introduced in successive years.

In 1923, four Chunnee crosses were obtained through Washington and are now released to the plantations and being tested: POJ 213, 234, 236, 979. In 1924: Kassoer, EK 28, Tjpering 24, J 36 M, POJ 2714, 2725, 2727. In 1925: Uba from Porto Rico, BH 10 (12), DI 52, SW 33, J 36 M, POJ 228, 826, 2379, 2364, 2714, 2725, 2727, Kassoer; while it is proposed to bring in during 1926: EK 28, St. Croix 10-12, Uba from Natal, Co 210, 213, 214. Many of these canes are interesting. Most of the POJ seedlings mentioned are hybrid canes resulting from crossing with Chunnee, but 2364, 2714, 2725 and 2727 are hybrid progeny of Kassoer. J 36 M is regarded as a probable mutation from POJ 36 with a good record from Formosa, where it heads a list of 12 canes with D 1135 and Rose Bamboo at the foot. DI 52 and SW 3 are commercial canes of Java, which on certain lands compare satisfactorily with EK 28, and the latter variety occupies over 40 per cent. of the cane area in the island. Tjpering (really Tjepiring) 24 is said to be a cross between Cheribon and Kassoer, drought resistant and more suited to light soils. Considerable doubts appear to exist whether the Uba cane of Hawaii is the same as that grown elsewhere, and this is the reason for the importation of this type of cane from Porto Rico and Natal.

Before considering the breeding programme in Hawaii, it may clear matters up a bit if we state briefly the relative position of Chunnee and Uba canes, which seem to enter largely into it. The Indian indigenous canes have been roughly divided into two main classes, the *Ukh* and the *Gunna*; and Chunnee is a representative of the former and Uba of the latter. This is not, however, a botanical classification, and it is not founded on morphological considerations. The *Ukh* canes are generally thinner and hardier than the *Ganna*, and occupy rather different ranges of country: the greatest concentration of the various members of the *Ukh* group is, speaking generally, further from that part of north India which is, in some sort, suited to the growth of tropical canes: geographically, the focus of the former may be placed in the north-west and of the latter in the south-east of the sub-Himalayan tract. All the cultivated forms of sugar cane are united botanically under *Saccharum officinarum*, but in every part of the Indian sugar tract a wild grass, *Saccharum spontaneum* is also met with. The Indian canes have recently been separated into a number of groups on morphological lines, although there are still others which have not yet been sufficiently studied. Chunnee and Uba may be taken as representatives of two of these groups, namely the Saretha and Pansahi respectively: while the former group shows marked similarity to the wild *Saccharum spontaneum*, the latter does not. All of the types thus far mentioned have been studied at the Coimbatore Cane Breeding Station; and crosses have been effected in all directions, wherever fertile flowers were obtainable, from *Saccharum spontaneum* to the tropical canes. The wild grass and members of the Saretha group readily produce masses of seedlings, while those of the Pansahi group have always proved difficult, especially as male parents, in that the pollen is usually sterile.

Many years ago crosses were made in Java between tropical canes and Chunnee; and more recently it has been considered probable that an apparently wild cane found there and called Kassoer is in reality a cross between a tropical cane and *Saccharum spontaneum*. In later years crosses have also been made between Kassoer and tropical canes in Java. Thus both from Java and from Coimbatore seedlings have become available with wild blood in them. Incidentally, the designation of *Saccharum spontaneum* as a "half-wild cane" is incorrect, as this species is a wholly wild plant and not a sugar cane at all. It is unfortunate also that the terms "Japanese" and "Chinese" should have been introduced in describing the Uba types, as this obscures their origin and has no foundation in fact.

This somewhat lengthy interpolation has been considered necessary because it is obvious from the Director's Reports that great attention is being devoted in Hawaiian breeding work to the laudable object of imparting a more robust constitution into the standard varieties grown, by crossing them with more hardy forms grown in the east. In 1923 this attempt was rewarded by a few crosses between Uba and D 1135; and a special effort made in 1924 produced 114 seedlings as follows: three with Badila, five with H 109 and the rest with D 1135. But the difficulty experienced with Uba has directed attention to Kassoer, which is reported "to be immune to nearly all diseases, and to impart its hardiness to its offspring." It is however recognized that in these cases first crosses are not likely to produce seedlings of commercial value in Hawaii; and thus a series of crosses is forecasted, with ever decreasing proportions of wild blood in them. This is well worth trying, although it is doubtful whether the regaining of good sucrose content in the juice may not be accompanied by proportionally less resistance to disease. This would of course be held constantly in view, and it is suspected that some at least of the ultimate seedlings obtained may combine the good characters of both parents. We note that three Coimbatore seedlings, which are reported to be drought-resistant, are about to be introduced. The latest advices from India and Mauritius appear to indicate that some of these seedlings resemble the POJ Chunnee seedlings in harbouring mosaic, while being themselves more or less tolerant to this disease.

(5) There seems to be nothing of importance as yet to report regarding work on the *Jeswiet system* of classification of canes, or on SHAMEL's work on *Bud selection.* The first of these "promises to be helpful," and the second presents both "encouraging and discouraging features."

Soil Surveys of individual plantations by STEWART are being steadily prosecuted, 24 plantations having been dealt with since the project was started five years ago. Useful information is thus being obtained regarding the manurial requirements of the different fields, a matter of special importance in Hawaii, on account of the very heavy annual costs of artificial manuring. The number of applications received indicates that this work is being appreciated.

(6) The 1924 Report concludes with the interesting suggestion that Hawaii has now a definite opportunity of a great improvement in the better use of her lands by *shorter periods of cropping.* The ideal would appear to be three crops in every two years, as two years are too long and one too short: irrigated and unirrigated, and early and late planting have, however, to be considered separately, so that the subject is rather complicated. The whole project is being approached from the point of view of rates of growth during the different months in summer and winter, so that month-growths are the dominating factor, rather than seasons ; and a useful curve is reproduced which throws much light on the subject. Because of Hawaii's northerly position, the rate of growth is much more rapid in summer than in winter. Early planted canes can be ripened off on irrigated plantations by withholding water towards the end of the second summer, but late planted fields and unirrigated lands are less easy to control. A considerable amount of evidence has been accumulated to show that the growth of canes in the second year is nothing like so rapid as in the first year after planting; and also that the older canes are not at all improved by allowing them to stand over during the second winter. But the subject is too intricate to be dealt with very briefly, and may be left for a later occasion. It has always appeared to the writer, whose experience has been gained in countries with annual crops, as strange that such long periods have been assigned to the Hawaiian sugar crops, especially when considering the latter-day importance of a quick turnover of capital. But, in the absence of local knowledge as to the actual growth of the canes according to season, he has imagined that the very heavy applications of quick acting nitrogenous manures may have had something to do with the matter. The subject has obviously been under consideration for years past, and the evidence already available has enabled AGEE to present a strong case for the shortening of the cropping period in general, although much remains to be done in regard to certain conditions.

C. A. B.

Mr. ARTHUR D. LITTLE, well known as a research chemist, in the course of a paper read recently before the American Institute of Chemical Engineers,[1] said that the handwriting on the wall that confronts the chemical industry reads: "The price of progress is research, which alone assures the security of dividends . . . . ." He once suggested to the purchasing agent of a great corporation, who bought many million dollars' worth of material a year, that large savings could be effected by the chemical control of his supplies. He closed the interview by saying: "I believe in chemistry all right, but I have a son who is a sophomore in Yale. He comes home every other Sunday and I get all of it I need from him." That company is now in the Receiver's hands. Not long ago Mr. LITTLE had to look over the balance sheet of a company which has paid no dividends for several years, and was at some loss to account for its poor showing until he read among its assets the item, "Laboratory Equipment $49.51."

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[1] *Ind. and Eng. Chem.*, 1925, 17, No. 8, 857.

The Central Sugar Factories at Antigua and St. Kitts, B.W.I.

By SIR FRANCIS WATTS, K.C.M.G., D.Sc.

The central sugar factory at Gunthorpe's, Antigua, which was first operated in the season 1906, was erected as a small pioneer factory in order to inaugurate the change from the muscovado system of sugar-making then in vogue to that of the modern central factory. As originally laid down this factory was provided only with a 6-roller set of mills and was designed to make about 3000 tons of sugar in a season. This soon proved to be inadequate, and from the outset the factory was steadily added to, until by the end of six or seven years the capacity of the factory had been so increased as to make it capable of manufacturing some 80 to 90 tons of sugar a day, the mills being increased to a 14-roller set, comprising a Krajewski crusher followed by four sets of 3-roller mills, the rollers being 60 by 30 ins. in size; substantial additions were also made to the evaporating equipment and other parts of the factory. Particulars of this equipment have been published from time to time, notably in *West Indian Bulletin*, Vol. IX, p. 79; Vol. X, p. 305; Vol. XV, p. 47; and Vol. XVIII, p. 134.[1]

The factory at Basseterre, St. Kitts, was first operated in 1912, seven years later than that at Antigua; it had the same object in view, namely, to aid in the transition from the muscovado system of sugar-making to that of the modern factory. Having had the advantage of the experience gained at Antigua, this factory was at once planned on a more adequate scale, being equipped at the outset with a 14-roller mill, having a Krajewski crusher followed by four 3-roller sets of mills, the rolls being 72 by 34 ins.; consequently, it has been necessary to make but little addition to the machinery already installed, and the factory stands to-day very much as originally planned. At first the output of the factory was much below its capacity; this was principally due to the difficulty of securing an adequate supply of canes, and this in turn was largely due to the difficulties experienced in extending the factory railway to the northern and western districts of the island, on account of the existence of great ravines which interposed serious obstacles to railway construction. Recently, however, these difficulties have been overcome, so that it is possible to convey to the factory practically all the canes grown on the island, and the factory is now working more nearly up to its capacity.

During the campaign of 1925 each of these factories has made its largest crop and has worked practically up to its full capacity. In these circumstances it may be interesting to consider the results obtained in order to see the extent to which they have justified the objects with which the factories were erected. The following salient figures taken from the laboratory reports enable one to appreciate the general efficiency of these two factories and to compare this with that of other factories in different parts of the world.

The Antigua factory made 14,632 tons of sugar from 128,989 tons of canes, or 1 ton of commercial sugar from 8·82 tons of canes; while that at St. Kitts made 15,563 tons of sugar, or 1 ton of commercial sugar from 8·35 tons of canes. It will be observed that the canes at Antigua were more fibrous and contained less sucrose than those at St. Kitts, while they also yielded juice of somewhat lower purity; consequently, they were rather more difficult to work. At all stages the recovery of sugar was higher in the St. Kitts factory than in the Antigua one; the St. Kitts mills recovered in the juice 94·89 per cent. of the

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[1] See also *I.S.J.*, 1910, pp. 178 and 287; 1912, p. 389; 1916, p. 208; and 1921, p. 132.

	ANTIGUA.	ST. KITTS.
Total canes crushed, tons	128,989	129,973
Commercial sugar made (96° pol.), tons	14,631·9	15,563
Tons of cane per ton of sugar	8·82	8·35
Tons of canes crushed per hour	34·96	43·79
Canes, sucrose per cent	12·93	13·07
,, fibre per cent.	15·51	13·88
Ratio, fibre/sucrose in canes	119·8	106·2
Bagasse, sucrose per cent.	3·10	2·48
,, fibre per cent.	50·46	51·47
,, water per cent.	45·28	45·13
Juice, total tons, diluted	119,493	131,791
,, calculated to undiluted	95,775	101,438
Maceration water per 100 cane	23·38	28·36
,, ,, ,, 100 fibre	118·5	204·3
Dilution water[1] per 100 normal juice	24·76	29·9
Purity mixed juice	82·75	84·54
,, last mill juice	72·85	72·82
,, clarified juice	83·46	86·7
,, syrup	83·39	87·2
,, final molasses	32·32	33·93
Filter-press cake, tons	1530	10
,, ,, sucrose per 100	3·02	—
Sucrose in juice per 100 of sucrose in cane (mill recovery)	92·68	94·89
,, commercial sugar per 100 of sucrose in juice (boiling house recovery)	90·80	92·68
,, commercial sugar per 100 of sucrose in cane (general recovery)	84·16	87·94
Commercial sugar per 100 of sucrose in cane	87·66	91·61
,, ,, 100 ,, juice	94·65	96·58
RECOVERY AND LOSSES PER 100 PARTS OF CANE.		
Sucrose recovered in sugar made	10·88	11·49
,, lost in bagasse	0·95	0·67
,, ,, filter-press cake	0·036	0·0
,, ,, molasses	0·93	0·90
,, undetermined losses	0·24	0·004
RECOVERY AND LOSSES PER 100 OF SUCROSE IN CANE.		
Sucrose recovered in sugar made	84·58	87·94
,, lost in molasses	7·23	6·92
,, ,, bagasse	7·32	5·11
,, ,, filter-press cake	0·277	0·031 (undetermined)
,, undetermined losses	0·59	—
CALCULATED COMPOSITION OF CANES		
Sucrose	12·93	13·07
Reducing sugar	0·80	0·48
Non-sugar	2·69	1·91
Fibre	15·51	13·88
Water	68·07	70·66
	100·00	100·00

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[1] That is, the portion of the maceration water recovered in the juice.

sucrose in the canes against 92·68 recovered at Antigua; similarly, the higher purity of the juice led to the recovery in the boiling-house at St. Kitts of 92·68 per cent. of the sucrose in the juice against 90·80 in the Antigua factory. In other words, 87·94 of the sucrose in the cane was recovered as sucrose in the commercial sugar at St. Kitts against 84·16 at Antigua.

It is interesting to note that at St. Kitts the filter-presses were almost entirely dispensed with: the scums, after careful treatment in subsiders, are mixed with the last-mill juice which is run on to the back of the second mill. The small amount of filter-press cake that was made mainly resulted from cleaning-up operations. The method adopted for dealing with subsider mud appears to have been quite successful; it does not appear to have interfered with the recovery of sugar from the juice, which in this factory was particularly good; 96·58 lbs. of commercial sugar were obtained from each 100 lbs. of sugar in the juice, equivalent to a recovery of 87·94 per cent. of sucrose.

It is probable that the success of the method is to a large extent due to the good character of the cane dealt with at this factory; with less perfect conditions there is danger of impeding the work of the mills, which may not freely take the bagasse when treated with the clarifier mud, the presence of which tends to make the rollers of the mills unduly smooth, so that special precautions have to be taken with regard to their grooving in order to ensure the ready passing of the bagasse. Factories contemplating the adoption of this method of dealing with the clarifier mud should proceed with caution and make careful investigations before undertaking any extensive alteration of their equipment: they should carefully consider whether the quality of the canes to be dealt with and the juice they yield are likely to be sufficiently good to give promise of success with this method.

At St. Kitts the sugar turned out was entirely Refiners' crystals, polarizing 96°, the actual average polarization for the season being 95·965. At Antigua more than one kind of sugar was made, including a certain quantity of white sugar: for purposes of comparison the amount of sugar produced has been calculated to 96° polarization.

No additional fuel beyond the bagasse produced was required at the St. Kitts factory, and at Antigua only 20 tons of crude fuel oil and 314 tons of wood were used, this being mainly due to the manufacture of a certain amount of sugar of a quality other than 96° Refiners' crystals.

The general interest in these factories lies, as has already been stated, in the fact that they were erected as pioneer factories for the purpose of determining and demonstrating how best to make the transition from the muscovado system of sugar making to that of the modern central factory. The muscovado system then held sway in the Leeward Islands and Barbados, but it appeared evident to some of the more enlightened planters that muscovado sugar might soon cease to find a ready market and that difficulties would ensue: furthermore, it was recognized that the methods employed were wasteful and the mills alarmingly inefficient. Information was lacking as to the manner in which a modern factory could be introduced in order to deal with the canes of the several comparatively small estates, how such a factory might be operated without disastrously disturbing settled conditions, how much such a factory would cost and what it would be able to effect, consequently there was much hesitancy over making the required drawings, which were discussed for several years before action was finally taken.

It may be interesting to know that the introduction of these factories was accomplished with comparatively little disturbance of the manner in which the estates were worked, the principal and almost only difference being that the canes when reaped were placed in the factory's railway trucks, the rest of the work of the estate being unaffected.

Enquiries tended to show that the small muscovado factories took from 14 to 16 or more tons of cane to make a ton of sugar with its proportionate amount of molasses, which molasses, it has to be remembered, had some market value, though at times this was very low. The improvement effected by the introduction of the factories will be appreciated from the fact that these latter make a ton of 96° sugar from 8·35 and 8·82 tons of cane respectively.

On surveying the work of these factories it is evident that the two islands concerned are now in possession of well equipped modern factories which should enable them to meet fair competition and to hold their own in the sugar world in a manner which would have been impossible had the muscovado method been retained. The work that has been done in them, coupled with the ready dissemination by the proprietors of information concerning their equipment and manner and cost of working, has exercised considerable influence on the development of sugar factories in other parts of the West Indies, a point which further justifies the interest taken by the Government in the establishment of the factory at Antigua, this having received a grant of £15,000. The factory at St. Kitts, however, was erected entirely without Government assistance.

It now remains to be seen whether the general price of sugar in the near future will be such as will enable producers to secure a profit, or whether the artificially depressed prices resulting from the enormous production of sugar in Cuba under peculiar conditions will result in sugar being produced at a loss. Such a condition could only be temporary, but it might have such disastrous effects that the producers less advantageously situated might find it impossible to continue the industry, or to re-enter it if once forced to suspend operations. These are questions of national importance, for it is now realized that sugar is one of the fundamental food supplies of the Empire.

So far as adequacy of machinery is concerned it is evident that the sugar growers of Antigua and St. Kitts have wisely taken steps to safeguard themselves as far as possible, and that their factories are well equipped and well operated.

The low sugar prices that have ruled in Cuba of recent months are reported to have left little if any profit to many sugar planters, with the result that sales of retailers of goods in general, and their purchases from the wholesalers in Havana, are depressed and business is not thriving.

The Blue Book for Mauritius for the year 1924, dealing with the sugar situation, reports that the crop of that year was disposed of at prices which were generally not remunerative, the net price being in the mean about Rs. 12·50 per 50 kg., as compared with Rs. 18·94 in in 1923. Since the cost of production is in the neighbourhood of Rs. 12 for the majority of the factories, many estates closed the year with a deficit.

A working test was recently carried out in New York with a battery of four Kopke separators which have been made there for the Hawaiian Commercial & Sugar Company. The demonstration was made with distillery slops as the available material corresponding closest in its physical characteristics to the residues from the settling tanks in a sugar factory. A perfect separation of the insolubles from the "slops" was reported. A large number of engineers and technologists who have clarification problems to solve in many industries were present, and these expressed their satisfaction at the practical working of the invention.

Basic Dyes as Flocculating Agents for Approximate Quantitative Determination of Colloids in Sugar-House Liquors.

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INTRODUCTION.

It is becoming generally recognized by beet and cane sugar chemists and technologists that the clarification of beet and sugar cane juices as now practised consists primarily in the elimination of a portion of the colloidal material present in the juice. Uneliminated colloidal material may be responsible for various operating difficulties, such as poor filtration, slow vacuum pan boiling, delayed crystallization of low purity massecuites, and off-colour sugar. A method making possible even an approximate determination of the quantity of this colloidal material, which is simple and rapid enough for use in the control laboratory, should therefore be of considerable value in the analytical control of factory and refinery processes. It is the purpose of this article to describe a method in which the use of certain basic dyes permits the rapid approximate quantitative determination of colloids within the limits discussed.

Dyes have been used in adsorption experiments with clays and laboratory-prepared colloids, but they have not been applied previously to the flocculation of the colloids present in sugar-house liquors. The flocculation of colloids may be accomplished by the addition of free ions with an electric charge the opposite of that of the colloidal particles, or by adding the quantity of oppositely-charged colloid required to produce mutual electric neutralization. When a negatively-charged colloid is mixed with a positively-charged colloid in a certain proportion a point of electrical neutrality is reached at which the electric charges exactly neutralize each other, frequently causing mutual colloid flocculation and producing a precipitate which settles out of solution. If at this so-called isoelectric point the liquid containing the suspended flocs is examined with an ultramicroscope fitted with a cataphoresis apparatus (see latter part of this article for description) no movement of the colloidal particles or aggregates toward either electrode is observed. The principle of flocculating colloidal suspensions by the use of oppositely-charged colloids has been studied and applied in several industries, such as the purification of drinking water by the use of alum. In applying the theory of electrical neutralization of colloidal particles to sugar-house liquors, it is assumed that all these particles are electro-negatively charged. This assumption appears to be correct, as all colloids separated from these liquors have been found to be electro-negative when tested in a cataphoresis apparatus. It has also been noted that in general the charge is reversed only at greater hydrogen-ion concentrations than are found in sugar-factory liquors.

INVESTIGATION OF VARIOUS BASIC DYES.

Some of the common substances which have been used for flocculating electro-negative colloids are the salts of aluminium and iron, and the basic dyes.[1] Basic dyes are usually manufactured as hydrochlorides, but sometimes they are in the form of sulphates or oxalates of dye-bases. Each of these dyes owes its basic properties to the presence of certain groups in its nucleus, such as $-N(C_2H_5)_2$, $-(NCH_3)_2$, $-NH$, and $-NHC_6H_5$. Dyes selected from the following groups have been tested for flocculating properties: Azo, triphenylmethane, pyrone, acridine, azine, oxazine, thiazine, thiazol, and quinoline. The best results were obtained with methylene blue, night blue, bismark brown, methyl violet B, and victoria blue B.

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[1] Basic dyes have been used in adsorption tests on soils for several years. Probably the latest work is by WILKINSON and HOFF, *Journal of Physical Chemistry*, 1925, 29, No. 7.

Methylene blue has been found by MATTSON[1] to give excellent results as a flocculating agent when used to study the isoelectric systems of clays. In studying the flocculation of clays he observed the movement of the colloidal particles by the aid of an ultramicroscopic cataphoresis apparatus, thereby obtaining an accurate check on the isoelectric point determinations. Methylene blue had a number of disadvantages in our work. It is difficult to produce uniform batches in manufacturing it, and samples vary so greatly that it is almost impossible to obtain two batches of the dye that will give exactly the same results with the colloidal material of sugar-house liquors. Of one dozen different samples tested, only one sample produced satisfactory flocculation; and up to the present time it has been impossible to obtain a duplication of this one sample of dye. With this difficulty in mind, it was decided to find a dye suitable for the electrical neutralization of sugar-house colloids which could be more readily obtained on the market. Night blue, victoria blue B, methyl violet B, and bismark brown fulfil these requirements. Uniform samples can be obtained from different sources and at reasonable prices. Of these four dyes night blue is preferred, as it produces the most rapid flocculation and a precipitate which settles most rapidly.

USE OF NIGHT BLUE AS A COLLOID REAGENT.

One-half gram of night blue is dissolved in freshly distilled water and the solution is diluted to 500 c.c. The solution in use should not be more than about one week old on account of possible change in the electric charge. It is best to ascertain by a preliminary determination the approximate range of flocculation within which the isoelectric point lies. This may be accomplished by delivering from a burette a volume of the liquid to be tested which contains about 100 mgrms. of solids and diluting it to 25 c.c. in a beaker. A portion of the dye solution is run into another beaker from a small burette or large graduated pipette and diluted to 25 c.c. The two solutions are thoroughly mixed by pouring back and forth several times. The total volume may be 50 c.c. or 100 c.c. (50 c.c. of water added), depending on the intensity of colour.

After allowing the mixture to stand for a few minutes, the beaker is held over an electric light (preferably placed in a box with circular opening in the top) and gently rotated or tilted. If sufficient dye has been added, a distinct flocculation which is clearly visible to the eye usually results. In case no flocculation is perceptible, the operation is repeated using more dye solution with a new solution of the sample to be investigated. If the first flocculation consists of very small particles it is evident that the colloidal particles are not completely neutralized, but still carry a portion of their original electric charge. The operation must then be repeated with an increased quantity of the dye solution. The approximate neutral point is ordinarily indicated by large flocs which settle rapidly, leaving a light-coloured supernatant liquid. Unless the method and proportions given are closely followed the range of flocculation will vary greatly, causing much unnecessary work. This part of the test may be termed an electrical titration. However, the result obtained in this way is only approximate.

After the approximate neutral point is ascertained, as described above, quantitative data may be obtained. A series of tall glass tubes is arranged, each tube containing 25 c.c. of a solution of the sample in which about 100 mgrms. of solids is present. To the first tube is added a quantity of dye solution diluted to 25 c.c. In each succeeding tube the dye concentration is increased in steps so as to cover the range of flocculation, the volume of dye solution added being in each case diluted to 25 c.c. For instance, if from 5 to 9 c.c. of dye solution was required to reach the approximate neutral point, the volume of original dye solution added to the tubes would range from 5 to 9 c.c. in steps of 0·2 or 0·5 c.c. The tubes are allowed to stand for a certain period, after which the three or four tubes containing solutions nearest the isoelectric point may be detected by observing the quantity of flocs and the colour of the supernatant liquid. As the precipitates in the tubes near the isoelectric point appear to have about the same volume after settling, the solutions in these three or four tubes are examined with an ultramicroscope provided with a cataphoresis attachment in order to determine which of the tubes contains the solution nearest the isoelectric point.

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[1] Unpublished paper on "Electrical Neutralization of Colloidal Material and the Isoelectric Point," by S. E. MATTSON, Bureau of Soils, U.S. Department of Agriculture.

CATAPHORESIS MEASUREMENTS.

Several methods for making ultramicroscopic measurements of the cataphoresis of colloidal particles have been described. Probably the most accurate and elaborate work has been done by SVEDBERG and ANDERSON[1]. However, their apparatus is unnecessarily complicated for the tests here described. A simple and inexpensive cataphoresis apparatus was made according to MATTSON'S[2] description with a few modifications to adapt it to our requirements. After the colloid-dye mixtures have stood for the required time the various tubes are shaken and the contents tested in the ultramicroscopic cataphoresis apparatus. The speed of the movement of the colloidal particles decreases as the quantity of dye added increases until a zero point is reached at which the particles do not move toward either electrode. Beyond this point the particles gradually acquire a positive charge with further addition of dye.

It is better technique to allow the flocculated samples to stand for at least 24 hours to permit complete equilibrium to become established between particles of opposite charges before making the cataphoresis examination. This period may be reduced to a few minutes by changing the procedure of flocculation, thereby giving results which are sufficiently accurate for most purposes and which are closely comparable. The sample of juice, syrup, or molasses is diluted to 10° Brix, and an aliquot (10-40 c.c.) of this solution diluted to 50 c.c. with water; the dye solution is then added with rapid stirring until sufficient dye has been added to produce a floc. Flocculation ordinarily occurs almost immediately, and after standing about 10 mins. the flocs usually begin to settle. The sample is then diluted to 100 c.c. with distilled water, shaken thoroughly, and examined immediately in the ultramicroscopic cataphoresis apparatus.

Complete neutralization is seldom shown at this stage. If the colloidal particles show a negative charge, a quantitative test must be made, using a series of tubes as previously described, the quantity of dye added being increased to cover the range of flocculation. If a positive charge is shown by the cataphoresis examination, the dye content must be decreased in the quantitative test. In employing this more rapid procedure it is best to use an aliquot of the solution of the sample containing from 100 to 700 mgrms. of solids, the exact weight varying in a general way inversely with the colloid content of the sample. The data obtained by this rapid method agree well with those obtained by the longer procedure in which the colloid-dye mixtures are allowed to stand 24 hours. The very small difference is probably due to the establishing of more complete equilibrium between the oppositely charged colloidal particles in the longer method ; failure to reach complete electrical neutralization quickly is apparently due to the time required for adsorption.

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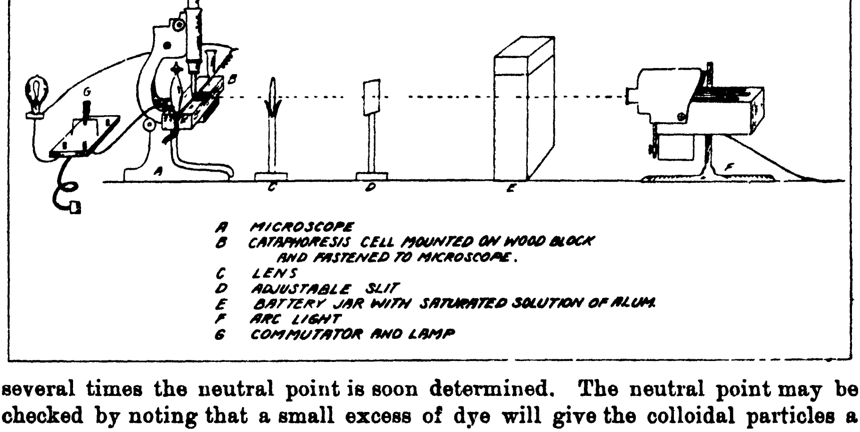
[1] *Kolloid Zeitschrift*, 1919, 24, 156.

[2] *Kolloid Chem. Beihefte*, 1922, 14, 309.

The use of a series of glass tubes in this test may be avoided by employing the following method, which is similar in nature to an intermittent titration. The sample of juice, syrup, or molasses, prepared as described, is delivered from a burette into a 400 c.c. beaker and diluted to 50 c.c. with distilled water. A measured quantity of the dye solution is added, and the mixture is thoroughly shaken before testing in the cataphoresis apparatus. If the particles are found to be negatively charged, the lower stopcock of one of the side reservoirs in the cataphoresis apparatus (*cf.* Fig. 1, and later description) is opened and the solution is washed out of the cell into the beaker containing the remaining portion of the sample. Two or three washings will usually remove any dye precipitate which might adhere to the glass cell. Additional dye solution is then added to this colloid-dye mixture, which is again tested in the cataphoresis apparatus. The neutral point is thus gradually approached, and after repeating this operation several times the neutral point is soon determined. The neutral point may be checked by noting that a small excess of dye will give the colloidal particles a positive charge. After a little practice the dye test may be made rapidly in this manner.

FIGURE I



A MICROSCOPE
B CATAPHORESIS CELL MOUNTED ON WOOD BLOCK AND FASTENED TO MICROSCOPE.
C LENS
D ADJUSTABLE SLIT
E BATTERY JAR WITH SATURATED SOLUTION OF ALUM.
F ARC LIGHT
G COMMUTATOR AND LAMP

The final data of the dye test may be conveniently expressed as an isoelectric ratio, i.e., the ratio of the weight (in mgrms.) of dye to the weight (in mgrms.) of solids, the colloid content of which is electrically neutralized by the dye. The value of this ratio is a measure of the colloid content of the sample within limits which will be discussed later in this article. After a little experience the complete dye test, including calculation of the isoelectric ratio, may be easily made in 10 mins., using the rapid form of the method.

RESULTS OF EXAMINATION OF RAW SUGAR AND MOLASSES.

The action of night blue was tested with satisfactory results in the case of beet molasses, blackstrap cane molasses, and cane juice. The following data illustrate the use of a basic dye for obtaining a rapid approximate quantitative estimation of the colloidal material present in sugar-house products. The data given in all the tables except No. 6 were obtained by using the procedure in which the tubes are allowed to stand 24 hours.

Table 1.—Examination of colloids in beet molasses.

193·8 mgrms. of solids ; total volume, 100 c.c.

Milligrams of Dye.	Order of Magnitude of Flocculation.	Migration Velocity of Colloidal Particles μ/sec./volt/cm.	*pH* at Isoelectric Point.
5·0	X	— 0·41	—
5·5	XX	— 0·35	—
6·0	XXXX	— 0·22	—
6·5	XXXX	0·00	6·23
7·0	XXX	+ 0·26	—
7·5	XXX	+ 0·39	—

Isoelectric ratio $\frac{6\cdot5}{193\cdot8} = 0\cdot0335$ .. —

Before examination, the beet molasses (Table 1) was passed through bolting cloth to remove relatively large particles. The approximate range of flocculation was first ascertained in the manner already described, and a series of tubes was then arranged with increasing quantities of dye. A slight flocculation appeared immediately, becoming quite pronounced on standing. The tube containing 6·5 mgrms. of dye showed the best flocculation and was isoelectric. In the column headed "Order of Magnitude of Flocculation," the extent of flocculation increases in the order X, XX, etc. It will be noted that after the neutral point is reached flocculation decreases and the electric charge changes from negative to positive.

The migration velocity (μ per second per volt per centimetre) of the colloidal particles is calculated by the formula $\frac{7\,\mu\,N}{H t_N}$, where H = Potential gradient (12·7 volts/cm. with the instrument used) ; t_N = time in seconds for a colloidal particle to traverse N divisions of the micrometer ; N = number of micrometer divisions the particle traverses ; 7 μ = width of one division of the micrometer.

The sign — indicates a negative charge and + a positive charge.

Table 2 gives the results of examination of a raw cane sugar sample (No. 1). The raw sugar solution was passed through an inclined 325 mesh screen to remove *bagacillo* and other particles of relatively large dimensions. This raw sugar sample was received from a refinery with the statement that it represented a shipment which was characterized by very poor filtration of the melt, an increased proportion of infusorial earth being required. An ultra-filtration test showed that the sample contained an unusually high percentage of colloidal material.

Table 2.—Examination of colloids in raw cane sugar (sample 1).

500 mgrms. of solids ; total volume, 100 c.c.

Milligrams of Dye.	Order of Magnitude of Flocculation.	Migration Velocity of Colloidal Particles μ/sec./volt/cm.	*pH* at Isoelectric Point.
1·00	X	— 0·96	—
1·50	XX	— 0·65	—
1·80	XXX	— 0·23	—
2·10	XXXX	0·00	6·21
2·30	XXXX	+ 0·20	—

Isoelectric ratio $\frac{2\cdot10}{500} = 0\cdot0042$

The results of examination of another raw cane sugar sample are presented in Table 3. This raw sugar solution was filtered in the same manner as the solution of raw sugar No. 1, and was then tested with the dye solution. The sample was received from the same refinery as sample No. 1, and was said to give a melt that filtered normally. An ultra-filtration test showed that this sample contained an average quantity of colloidal material for this type of sugar. The isoelectric ratio of this sample is much smaller than that of raw sugar No. 1, indicating the presence in it of considerably less colloidal material.

Table 3.—Examination of colloids in raw cane sugar (*sample 2*).

500 mgrms. of solids; total volume, 100 c.c.

Milligrams of Dye.	Order of Magnitude of Flocculation.	Migration Velocity of Colloidal Particles μ/sec./volt/cm.	*pH* at Isoelectric Point.
0·70	0	— 0·65	—
1·20	XXX	— 0·13	—
1·35	XXXX	0 00	6·29
1·50	XXXX	+ 0·12	—
1·90	XXX	+ 0·27	—
2·20	XX	+ 0·44	—

$$\text{Isoelectric ratio } \frac{1 \cdot 35}{500} = 0 \cdot 0027$$

(*To be continued.*)

The World's Consumption and Visible Supplies at August 31st.

The following interesting data are taken from a recent issue of Willett & Gray's *Sugar Trade Journal.* The figures are in long tons of 2240 lbs.

"A prominent Belgian refiner has compiled the following table, which indicates an apparent world's consumption for a campaign period—September 1st to August 31st—for several years. The table covers stocks in what are usually considered statistical countries, but excludes stocks elsewhere throughout the world, particularly Java, Japan, etc., although the full production of such countries, as given by Willett & Gray, is included in the supplies.

"The interesting point of this calculation is the steady absorption of continually increasing supplies, the most striking of which is the campaign just about finished (1924-25) when world's supplies were about 3,500,000 tons in excess of the previous campaign, and which excess was almost entirely consumed, as final stocks on August 31st, 1925, were only 717,000 tons larger than at the end of the preceding campaign.

"As the campaign now under way only shows an increase of about 653,000 tons, and as prices are low, it would indicate that stocks on August 31st, 1926, should return to the figure of August 31st, 1924.

	1925-26. Tons.	1924-25. Tons.	1923-24. Tons.	1922-23. Tons.
Stocks September 1st, Europe..	607,000	387,000	650,000	576,000
Stocks Sept. 1st, U.S. and Cuba	1,487,000	990,000	815,000	892,000
Total Stocks	2,094,000	1,377,000	1,465,000	1,468,000
World's Production	24,242,000	23,589,000	20,121,000	18,321,000
	26,336,000	24,966,000	21,586,000	19,789,000
Apparent Consumption	(?)	22,872,000	20,209,000	18,324,000
Final Stock, August 31st	(?)	2,094,000	1,377,000	1,465,000

According to the Standard Bank of South Africa Monthly Review, the final yield of the sugar crop, in that country given normal conditions to the end, will be approximately 225,000 short tons. Export was proceeding steadily at the end of November and about 40,000 tons had been shipped with a prospect of a further 16,000 tons. Demand for sugar within the Union has been dull, but is expected to improve with the commencement of the fruit season.

Hawaiian Factory Equipment Data.

By G. H. W. BARNHART.

One interesting phase of a comparison of data covering the different factories in Hawaii is the great variety in size and arrangement of equipment.[2] There are 9 distinct lengths of mill rollers from 42 ins. to 84 in. There are 17 nine-roller mills, 11 preceded by two-roller crushers, 4 by three-roller crushers, and 2 by no crusher at all. Of 20 twelve-roller mills (two factories having two tandems each), 17 are preceded by two-roller crushers, 1 by a three-roller crusher, and 2 by no crusher at all. There are two fifteen-roller tandems, each preceded by a two-roller crusher, and 2 eighteen-roller tandems, one preceded by a two-roller, the other by a three-roller crusher. The predominance of the twelve-roller tandem, with two-roller crusher, indicates it as standard equipment. Thirty-six of forty factories use crushers, 7 of these being three-roller crushers, which are popular because the installation is identical with a three-roller mill except for the coarser grooving and because of a somewhat better extraction. Twenty-nine factories report the use of knives, 8 of them having double sets. There are 14 Searby Shredder installations, while one old "National" is still doing service.

Practically every size of engine offered by manufacturers is to be found, the predominating makes being the Putnam, Edward Wood, Hamilton, Corliss and Nordberg. The possible indicated horse power (I.H.P.) developed in each factory has been found by calculation, using the size, speed and initial and final pressures reported and a mean effective pressure (M.E.P.) corresponding to 0·40 cut-off. It will be noted that this I.H.P. capacity per T.C.H. varies from 10·1 at Halawa to 39·8 at Olowalu. Observations indicate that for a fairly uniformly loaded mill train the power required varies as the number of mills in the train—being 30 I.H.P. per T.F.H. for three-roller crushers and three-roller mills and 15 I.H.P. for two-roller crushers. Assuming an average fibre of 12½ per cent. these figures become 3·75 and 1·875 I.H.P. respectively per T.C.H. and the power requirements for different mill arrangements are :—

ARRANGEMENT.	I.H.P.	ARRANGEMENT.	I.H.P.
6 RM and 2 RC..	8·875	12 RM and 2 RC..	16·875
9 RM	11·250	12 RM and 3 RC	18·750
9 RM and 2 RC..	12·625	15 RM and 2 RC..	20·625
9 RM and 3 RC	15·000	18 RM and 2 RC	24·375
12 RM	15·000	18 RM and 3 RC..	26·250

A comparison of the available with that required indicates five factories to be underpowered, whilst a few have sufficient power and many have quite an excess.

To assist in determining the average capacity of a cane mill for Hawaiian conditions the table below is given. All mills in this class are preceded by revolving knives and a crusher.

The maximum possible capacity is considerably in excess of the figures given, but these represent the grinding rate at which uniformly good work can be maintained.

The installation of a Searby Shredder in any of these installations, after the crusher, can be expected to increase the capacity as much as 20 per cent. without affecting the extraction, or to increase the extraction, 2·5, 1·25 or 0·8 per cent. respectively, depending on whether the installation consists of a 9, 12 or 15-roller

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[1] Abridged from a paper presented to the Fourth Meeting of the Association of Hawaiian Sugar Technologists, October, 1925

[2] Comparison of these data may be made with those last reported for T.H. See *I.S.J.*, 1920, 156-159.

Size of mill and number of rollers.	Tons fibre hour.	Tons cane per hour at fibre of					
		10 per cent.	11 per cent.	12 per cent.	13 per cent.	14 per cent.	15 per cent.
26 × 42 9 RM	1·82	18·2	16·6	15·2	14·0	13·0	12·1
26 × 42 12	2·24	22·4	20·4	18·7	17·2	16·0	14·9
26 × 54 9	2·52	25·2	22·9	21·0	19 4	18·0	16·8
26 × 54 12	2·94	29·4	26·7	24·5	22·6	21·0	19·6
30 × 60 9	3·78	37·8	34·4	31·5	29·1	27·0	25·1
30 × 60 12	4·33	43·3	39·4	36·1	33·3	31·0	28·9
32 × 60 9	4·06	40·6	36·9	33·8	31·2	29·0	27·1
32 × 60 12	4·76	47·6	43·3	39·6	36·7	34·0	31·7
32 × 60 15	5·32	53·2	48·4	44·2	40·9	38·0	35·5
32 × 66 9	4·76	47·6	43·3	39·6	36·7	34·0	31·7
32 × 66 12	5·32	53·2	48·4	44·2	40·9	38·0	35·5
32 × 66 15	6·02	60·2	54·7	50·1	46·4	43·0	40·1
34 × 72 9	5·88	58·8	53·5	49·0	45·3	42·0	39·2
34 × 72 12	6·58	65·8	59 8	54·7	50·6	47·0	43·8
34 × 72 15	7·28	72·8	66·2	60·6	56·0	52·0	48·5
34 × 78 9	6·30	63·0	57·3	52·5	48·5	45·0	42·0
34 × 78 12	7·14	71·4	64·9	59·4	54·9	51·0	47·6
34 × 78 15	8·13	81·3	73·9	67·7	62·5	58·0	54·2

mill, if the grinding rate is not increased. Records are available which indicate grinding rates 50 per cent. in excess of the above figures as a direct result of the shredder installation.

BOILERS.

Boiler heating surface has been calculated on a basis of fire-tube boilers, water-tube surface being included as fire-tube surface by multiplying it by 1·2. Excluding Honolulu Plantation, which refines its sugar, and requires a greater heating surface, the range is from 275 sq. ft. to 676 sq. ft., the average being 470, which is slightly more than the Hawaiian standard of 450 sq. ft. in fire-tube boilers.

Grate area ranges from 1 sq. ft. per 52·7 sq. ft. of boiler heating surface, to one per 200·0. Excluding the two low and three high figures, the range is from 75 to 145, and the average being 97·5 this is roughly 1 sq. ft. of grate area per 100 sq. ft. of boiler heating surface.

Combustion volume, as measured to the point where gases first come in contact with boiler tubes or shell, ranges from 1 cub. ft. per 3·125 sq. ft. of boiler surface to one per 14·93. Omitting the four extremely low and five extremely high figures, the range is 5·15 to 9·61 and the average 7·45, so that 1 cub. ft. of volume to each 7·50 sq. ft. of heating surface may be taken as an average.

Grate area ranges from 1·93 to 7·33 sq. ft. per ton cane hour, and combustion volume from 7·10 to 127·2 cub. ft. per T.C.H., both of which indicate the extreme variation through which it is possible to obtain passable or even good work.

JUICE HEATERS.

Tubular juice heaters are used exclusively to heat juices in T. H., but the baffled type is being rapidly adopted. They are used either for heating or re-heating raw juice, or re-heating the secondary mixed juice in the case of the Petree process, and use live or exhaust steam or vapour from a pre-evaporator as the heating medium.

The various capacities per T.C.H. reported range from 18 to 54·5, the average being 28·8 for mixed juice, as compared with the Hawaiian standard requirement of 35 sq. ft., and from 9·00 to 22·67 for re-heating. In the juice-heater, work done is dependent on heating surface and steam pressure, a restricted surface requiring a high steam pressure, a low pressure necessitating a large heating surface. The heating surface required may be calculated from the formula $H.S. = \frac{10{\cdot}23 \times T_d \times J}{T_m \times K}$ where T_d = temperature rise in F°; J = tons of juice per ton of cane (1·2 for mixed juice; 1·3 for clarified); T_m = mean temperature difference between juice and steam; K = decimal figure expressing efficiency of steam with steam at zero gauge as unity. (For each 1 lb. increase or decrease in pressure, increase or decrease the figure 4·4 per cent.)

The calculation indicates 16·7 sq. ft. at 8 lbs. gauge, 22·3 at 5 lbs., and 33·1 at 2 lbs. gauge.

SETTLING TANKS.

Seven of 40 factories report the use of continuous settlers, 4 using Dorrs, and 2 the Colonial Sugar Refining type. Of the remaining factories, 20 use cylindrical tanks with conical bottoms, 1 uses old boilers, 3 use rectangular tanks with sloping bottoms and 5 simply designate their tanks as of the intermittent type. Capacities range from 51 to 121·8, the average being 81·2 cub. ft. per T.C.H., as compared with the standard requirement of 72 cub. ft.

FILTER-PRESSES.

The filtering area ranges from 58·8 to 160·0 sq. ft. per T.C.H., the average being 103·7 where standard practice requires 120 sq. ft. Excluding the high and low figures, 73 per cent. of the factories have areas ranging between 91·5 and 134·5 sq. ft. Filter-presses are not used in 3 Petree process factories. Kopke centrifugal separators, have been installed in one factory to assist in reducing the quantity of impurities in circulation; but the centrifugal area now used—0·44 sq. ft. per T.C.H.—is insufficient. An area of 1 sq. ft. per T.C.H. is recommended in conjunction with Peck strainers using 150-mesh wire cloth.

PRE-EVAPORATORS.

Nineteen factories report this equipment. One has discontinued its use another uses it as a pre-evaporator "ordinarily" and as the first effect of a quadruple when the mill engines stop; a third uses vapour for heaters and pans, a fourth sends vapours to heaters and the final body of a triple, and one uses vapours for heating, re-heating and in a double effect. With the remainder it is used with triple or quadruple effects.

The pre-evaporator may be installed either as a means of increasing evaporation capacity, or for fuel conservation, or both. It is difficult to state just where a pre-evaporator becomes necessary from a capacity standpoint. Since the capacity of a quadruple effect can be increased 66 per cent. by raising the initial pressure from 2 to 8 lbs., and an additional 26 per cent. if syrup is sent on at 60 instead of 70° Brix, it is apparent that practically double the amount of work can be done at this station provided those in charge are willing to sacrifice at other stations. Ample pan capacity will warrant passing on the syrup at 60° Brix, and large mill engines will enable the mill to operate against a high back-pressure with a higher steam consumption. Where live steam is used in processing in fairly large quantities and where extra fuel is required, the pre-evaporator will ordinarily prove a desirable addition.

Reported pre-evaporator capacities range from 32 to 112·3 sq. ft. of heating surface per T.C.H. The following tabulation indicates the surfaces required when the pre-evaporator is used for heating the entering juices and doing some evaporating, the vapours being used for heating the mixed juice to 212° F., and the calandria pressure being as shown:—

	Steam pressure—lbs. gauge				
	6	7	8	9	10
Sq. ft. H. S. for heating	14	9	6	4	3
Sq. ft. H. S. for evaporation	115	64	45	36	30
Total H. S. required	129	73	51	43	33

EVAPORATORS.

Ten factories report the use of triple effects, seven of these being in conjunction with pre-evaporators. In the tabulation the surface of triple effects has been expressed as quadruple heating surface by multiplying by 4/3. Heating surfaces range from 160 to 394 sq. ft. per T.C.H.; and 225 sq. ft. has been taken arbitrarily as the dividing line between insufficient and sufficient or ample capacity. Six of the factories with surfaces from 211·5 to 223 are just below, and three of these five use pre-evaporators. Three other factories with 160, 181 and 185·3 sq. ft. respectively, appear to be decidedly deficient. The two last being supplemented with ample pre-evaporator capacity which is equivalent to 40-45 sq. ft. in a quadruple. The first with 160 sq. ft. and without an assisting pre-evaporator is apparently hard put to thicken its juices. An excess of heater capacity, however, assists by heating entering juices to the boiling point in the first cell of the evaporator, and a rather unusually large pan capacity enables one to handle the thin syrup sent to this station, although this is at a sacrifice in steam economy. Three factories report the use of Lillie evaporators in conjunction with standard effects. One uses a horizontal submerged tube evaporator.

The heating surface required in an evaporator is dependent primarily on the steam pressure in the calandria of the first cell, although the density to which evaporation is carried, and the vacuum in the last body each has its effect. That required under varying conditions is given below:—

Initial pressure lbs. gauge.	26 in. vacuum in last body		24 in. vacuum in last body	
	13—70 Brix.	13—60 Brix.	13—70 Brix.	13—60 Brix.
2	350	303	431	376
5	255	228	302	271
8	201	182	232	212

THE "EXTRA USE" OF STEAM.

In view of the diversity in the arrangement and amount of heating surface used in evaporation to syrup, some comment is in order. Since standard arrangement appears to include the quadruple effect, the steam requirement with this equipment has been contrasted in the table below with other arrangements:—

Exhaust steam to—	Tons steam per ton cane per hour.	Per cent.
Triple, heaters and pans	0·5924	117·7
Triple, pre-evaporators and pans (vapours to heaters)	0·5432	107·8
Quadruple, heaters and pans	0·5041	100·0
Quadruple, pre-evaporators and pans	0·4734	94·0
Quintuple, heaters and pans	0·4712	93·5
Quintuple, pre-evaporators and pans	0·4217	83·7

The economy of a quadruple over a triple and pre-evaporator, and of the latter over a straight triple, is apparent. The tabulation shows a very slight difference in economy in favour of a quintuple over a quadruple and pre-evaporator, but the controlling factor undoubtedly is the capacity, for, with the same total heating surface, the combination with a pre-evaporator has 15 per cent. greater capacity.

PAN SUPPLY TANKS.

Excluding the few extremely low and high valves, the total supply tank capacities range from 60 to 134, and the average is 90·5 cub. ft. per T.C.H. for combined syrup, remelt and molasses. In general, this capacity is divided about equally between syrup with remelt, and molasses.

VACUUM PANS.

The following pan capacities are desirable when cane polarizes 14, and syrup purity varies as given below :—

	SYRUP	GRAVITY	PURITY.				
	90	88	86	84	82	80	78
Shipping sugar	42·1	41·4	40·8	40·1	39·5	38·7	37·6
Low grade	12·2	15·6	19·2	22·9	26·8	30·9	35·2
Total cub. ft.	54·3	57·0	60·0	63·0	66·3	69·6	72·8

The required heating surfaces per T.C.H. depend mainly upon the available steam pressures and range from 37·1 sq. ft. at 8 lbs. gauge, to 51·5 at 5 lbs., to 60·0 at 4 lbs. and to 80·7 sq. ft. at 2 lbs. gauge. A ratio of not less than 1 sq. ft. of heating surface to each cub. ft. of capacity is recommended, and if it is at all possible that back pressures are to be reduced below 4 lbs. gauge, the additional heating surface should be included, as its cost will be a very small part of the pan installation.

The range for Hawaiian factories is from 23·3 to 98·8 sq. ft., and 32·8 to 105·2 cub. ft., the average heating surface being 58·7 sq. ft. per T.C.H.

VACUUM PUMP DISPLACEMENT.

The average vacuum pump displacement for factories reporting is 32·8 cub. ft. per min., the range 7·41 to 79·40. The desirable capacities in cub. ft. per min. per T.C.H. with a vacuum of 27 in. in counter-current condensers are :—

	TEMPERATURE OF INJECTION WATER, DEGREES F.				
	75	80	85	90	95
Pans	14·4	16·8	21·6	28·2	40·2
Quadruple effect	10·5	12·5	15·0	17·0	29·5
Total	24·9	29·3	36·6	45·2	69·7
Pump displacement	37·4	44·0	54·9	67·8	104·4

Since a volumetric efficiency of approximately 67 per cent. applies to vacuum pumps under these conditions, the desirable total should be increased by 50 per cent. so that the required displacement would be as shown.

It will be noted that the capacity required varies with the temperature of injection water. Temperatures ranging from 69·8°F to 110°F. have been reported. The latter undoubtedly results when the flume water supply fails during dry years and the cooling pond, together with a slight amount of make-up, is used at the mill.

CONDENSER WATER REQUIREMENTS.

A 5°F. drop from vapour to tail water in counter-current condensers is thought to be ample, as many installations are operating on a 2–3°F. drop and reputable condenser manufacturers design on the basis of a 1·5°F. drop. Below are the calculated average quantities of water required per T.C.H. :—

	TEMPERATURE OF INJECTION WATER, DEGREES F.				
	75	80	85	90	95
In millions of galls. per day	0·0638	0·0740	0·0885	0·1130	0·1542
In galls. per minute	44·4	51·5	61·5	78·7	117.4

For triple effect evaporation these figures should be increased by 25 per cent.; for triples with a pre-evaporator, increased by 10 per cent., and for quadruples with pre-evaporator, decreased by 11 per cent. The maximum instantaneous demand when placing a pan in service might easily be 60 per cent. in excess of the average given.

HAWAIIAN FACTORY EQUIPMENT, 1925.

	Standard.	Oahu.	Pioneer.	H. C. & S.	Hawaiian Sugar.	Ewa.
Listed capacity, tons cane per hr.	1	125	90	160	50	37
	—	K	K	K (2)	K	K (2)
Milling equipment	—	2 RC 78	2 RC 72	2 RC 78	2 RC 72	2 RC 78
	—	S 72	S 72	S 72	S 72	—
	—	12 RM 78	15 RM 72	12 RM 78	12 RM 78	18 RM 78
Capacity at tonnage ratio of 2·0	—	140·8	72·0	140·8	70·4	98·6
Mill engines, I.H.P.	—	18·6	17·2	16·64	25·5	18·6
Furnaces—						
Sq. ft. grate area	4·5	1·93	—	3 38	6·74	—
Cub. ft. combustion volume.	60	7·10	—	95·21	72·92	—
Boilers—						
Sq. ft. H.S. (w.t.)	450	331·7	415·0	349·3	505·7	633·0
Juice Heaters, sq. ft. H.S.—						
Mixed juice	35	32·0	24·3	23·65	35·1	25·7
Clarified juice	10	—	20·0	18·41	—	—
	—	—	—	P. & S.	—	—
Settling Tanks—						
Cub. ft.	80	83·2	78·8	95·53	66·84	92·9
Filter-Presses—						
Sq. ft. filter area	120	67·2	71·1	k	105·9	88·9
Pre-Evaporator						
Sq. ft. H.S.	80	44·0	—	32·99	—	69·0
Quadruple Effect—						
Sq. ft H S.	300	232·0	266·7	253·4	280·0	339·0
Pan Supply Tanks, cub. ft.—						
Syrup, remelt, etc.	50	54·9	51·2	45·0	40·6	40·4
Molasses	50	—	82 0	30 0	63·0	17·4
Vacuum Pans (P)—						
Shipping Sugar:						
Sq. ft. H.S.	40	30 4	45·4	30·4	46·6	29·7
Cub. ft.	40	30·0	43·3	32·5	43·5	35·1
Low-Grade:						
Sq. ft. H.S.	20	24·8	33·7	29·7	32·4	19·8
Cub. ft.	20	21·6	28·8	25·0	30·0	22·9
Total:						
Sq. ft. H.S.	60	55·2	79·1	60·1	79·0	49·5
Cub. ft.	60	51·6	72·1	57·5	73·5	58·0
Vacuum Pump Displacement (v)—						
Cub. ft. per minute	35	7·41	—	36·78	—	17·42
Crystallizers (P)—						
Cub. ft.	300	118·4	492·1	240·0	246·4	329·0
Centrifugals, sq. ft. Screen Area						
Shipping Sugar	2·5	1·34	2·79	1·70	2·50	1·92
Low-grade	5·0	2·36	5·85	3·28	4·40	6·19
Total	7·5	3·70	8·64	4·98	6·90	8·11

w.t. = water-tube heating surface included as fire-tube by multiplying by 1·2.

P. & S. = for primary and secondary juices (Petree process).

k = Kopke clarifiers 0·44 sq. ft. per T.C.H. Recommended capacity 1·00 sq. ft. per T.C.H.

v vacuum pump displacement required varies with temperature of injection water.

P → capacities in pans, crystallizers, and centrifugals depend to a large extent on juice purity. Standards used are fair averages.

Hawaiian Factory Equipment Data.

CRYSTALLIZERS.

Crystallizer capacities range from 161·7 to 492·1, and combined tank and cooler capacities from 491·0 to 1013·5 cub. ft. per T.C.H. The capacity required depends upon many factors and may be found from :—

$$\text{Cub. ft. per T.C.H.} = \frac{3\ PDH \times (S-J)\ (s-M)}{J \times (s-j)\ (S-M)}$$

in which P = cane polarization ; D = number of days in crystallizer (including time for filling, emptying and cleaning) ; H = number of hours factory grinds per week ; S = gravity purity of shipping sugar ; J = gravity purity of syrup ; M = gravity purity of final molasses ; s = gravity purity of second sugar ; and j = gravity purity of second massecuite.

It is noticeable that 10 factories (which produce but slightly over 11 per cent. of the Hawaiian crop) are still using tanks and coolers exclusively, holding low grades up to 60 days.

The tendency and modern practice is to boil to grain, and drop to crystallizers where motion is maintained until the possibility of the formation of false grain is past. The water-cooled crystallizer, which has just been developed in the Philippines, promises to reduce this time considerably. In fact, there are some who advocate crystallizers to hold massecuite two days only, the remainder of the cooling being done in tanks without stirrers.

CENTRIFUGALS.

Screen area in shipping sugar machines ranges from 1·34 to 4·19, in low-grade machines from 1·46 to 7·50, and total centrifugal screen area from 3·70 to 9·51 sq. ft. per T.C.H. The requirements, when the shipping sugar cycle averages 10 min., and the low-grade cycle 60 mins., are as follows :—

	90	88	86	84	82	80	78
Shipping sugar	2·845	2·805	2·760	2·710	2·666	2·612	2·555
Low-grades	2·292	2·901	3·568	4·250	4·970	5·745	6·530
Total	5·137	5·706	6·328	6·960	7·636	8·357	9·085

During the 1924 crop 575,330 tons of molasses were produced in Java to the amount of 3·2 per cent. of the cane, and this was used in the following way :—For the production of hardened molasses for export, 15 ; for export, 23 ; consumed in Java, 4 ; used as fuel, 3 ; used as manure, 16 ; used for alcohol production, 10 ; wasted during hardening and thrown away, 27 ; and unaccounted for, 2 per cent. Thus in all 38 per cent. was exported, 19 per cent. used locally for manure and fuel, and 10 per cent. used locally for spirit manufacture.

Dr. H. CLAASSEN[1] recently stated the production costs of German sugar factories for the years 1924-25 in comparison with the year 1913-14, finding the cost of the roots to be 140-150 per cent. higher, and the cost of manufacture to be 281 per cent. higher (for factories over 500 tons of roots). Taxes are now about 18·8 pfennigs against 2-4 per 100 kg. of roots before the war. Comparing the average of the Czecho-Slovakian and Dutch costs of production with the average of the German for 1924-25, the former are lower by 55 pf. per 100 kg. of roots. Altogether, therefore, the German industry is working greatly at a disadvantage, and is unable to compete on the world's market, as against cane-growing countries like Cuba and Java. German factories must therefore obtain sufficient extra price to make up for the greater cost of production of 4-5 marks per 100 kg. of sugar. In order to compensate for the higher cultural costs for roots resulting from the heavy agricultural taxes and rents, an increase in the price of sugar is necessary.

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[1] *Centr. Zuckerind.*, 1925, **33**, No. 39, 1249.

Precipitation of Calcium Sulphite under various Conditions, with Special Reference to Sugar Manufacture.[1]

By R. G. W. FARNELL,
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The use of lime for neutralizing acidity and precipitating impurities from juice is universal in sugar factories. The removal of the troublesome colloidal impurities is brought about chiefly by their adsorption on inorganic precipitates formed in the juice itself. Since cane juice contains phosphatic ions a copious precipitate of calcium phosphate (principally) is formed when lime is added to the juice until neutrality is reached. This precipitate adsorbs much colloidal matter and the juice is thus "cleaned."

Frequently sulphurous acid is used in addition to lime. Raw mill juice is sulphured, lime is added to approximate neutrality, *pH* 7; then the juice is heated to 100°C. and run into tanks to allow the precipitated calcium sulphite and phosphate to settle out with the colloidal matter. In Java it is the practice to heat the raw juice first to 80–85°C., and then to sulphur and lime simultaneously. Under these conditions there is a better precipitation of the sulphite.

It is obviously desirable to precipitate as completely as possible the various insoluble calcium salts in order to give the maximum surface for colloid adsorption, to minimize subsequent scaling, and to diminish the amount of molasses, the formation of which is largely caused by the presence of salts.

The optimum conditions for precipitating these various calcium salts are not known. The author has chosen first to study the formation and precipitation of calcium sulphite, now to be described. The precipitation of calcium phosphate will be given in another paper.

REVIEW OF THE LITERATURE.

The chief factors governing the formation and precipitation of calcium sulphite appear to be: (1) Solubility of calcium sulphite, (2) reaction, (3) temperature, (4) oxidation.

(1) *Solubility.*—WEISBERG[2] GEESE,[3] ROBART,[4] and VAN DER LINDEN,[5] have all determined the solubility of calcium sulphite both in aqueous solution, in pure solutions of sucrose, and in beet and cane syrup. Very different values were obtained depending on whether the calcium sulphite was stirred up with the solvent, (static method of WEISBERG, ROBART and VAN DER LINDEN), or whether the calcium sulphite was precipitated from solution by the interaction of lime and sulphurous acid, (method of GEESE). Unfortunately the static method does not represent what occurs during the process of sulphitation as carried out in sugar factories; for here, instead of approaching calcium sulphite saturation from the unsaturated side, an attempt is made to approach saturation from the supersaturation side (*c.f.* GEESE).

At the end of his paper VAN DER LINDEN summarized his results as follows: (1) The solubility of calcium sulphite both in water and in sugar solutions is extremely small. (2) The solubility in sugar solutions is greater than in water. (3) The solubility of calcium sulphite both in water and in sugar solutions is greatly diminished in the presence of excess calcium sulphate. (4)

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[1] Abridged from the *Journal of the Society of Chemical Industry*, 1925, **44**, 530 T.
[2] *Bull. Soc. chim.*, 1896, **15**, 1247. [3] *Z. Ver. deuts. Zuckerind.*, 1898. **48**, 102.
[4] *Bull. Assoc. Chim. Sucr.*, 1913, **31**, 108. [5] *Archief*, 1914, **22**, 1113.

The solubility both in water and in sugar solutions diminishes on increasing temperature.

Van der Linden pointed out that the small solubility which he found could not possibly account for the great precipitation of calcium sulphite on heating the juice, and for the heavy sulphite scaling. Other factors came into operation and the solubility was greatly increased by the presence of certain colloidal constituents. This has been investigated during the present work.

(2) *Reaction.*—It is not certain what final reaction must obtain on neutralizing sulphurous acid with calcium hydroxide. The neutralization curve H_2SO_3-$Ca(OH)_2$ has not been recorded in the literature (see Fig. 1). The use of ammonia for precipitating calcium sulphite from "bisulphite liquor" suggests that the calcium sulphite reacts alkaline, and that its solubility is depressed in alkaline solution. This has been confirmed during the present investigation.

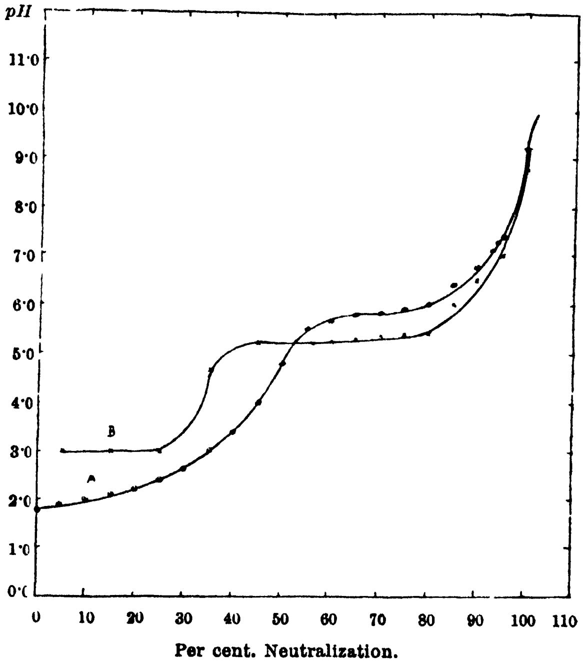

Fig. 1.

Neutralization of sulphurous acid by calcium hydroxide.

Sulphurous acid 0·046 *N*. Calcium hydroxide 0·046 *N*.

A. Solution mixed at 20°.

B. Solution mixed at 20° then boiled and cooled.

It has been suggested by Brewster and Raines,[1] that lime need not be added to sulphured cane juice beyond neutrality, *pH* 7, this being sufficient to precipitate all the calcium sulphite. Experiments to be recorded do not altogether substantiate this statement.

(3) *Temperature and decomposition of calcium bisulphite.*—The experiments of van der Linden and of Geese indicated the solubility of calcium sulphite to diminish with rise of temperature. It is certain that the precipitation of calcium

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[1] *I.S.J.*, 1923, **25**, 88.

sulphite is facilitated by heating, and statements are frequently made in the technical literature that calcium bisulphite is thereby decomposed into calcium sulphite and sulphurous acid.

Experiments recorded later do not indicate that any calcium bisulphite is decomposed into the normal sulphite below 100° C, and during a time interval not exceeding one hour. It is possible, however, that some oxidation of calcium bisulphite occurs: $Ca(HSO_3)_2 + \frac{1}{2}O_2 = CaSO_4 + SO_2 + H_2O$.

(4) *Oxidation of sulphurous acid and of sulphites.*—BALY[1] found that aqueous solutions of sodium and potassium metabisulphite oxidized as follows: $K_2S_2O_5 + \frac{1}{2}O_2 = K_2SO_4 + SO_2$. SAILLARD[2] performed exhaustive experiments on the oxidation of alkali sulphites by air, and found that sucrose, asparagin, glutamic acid, etc., acted as negative catalysts. Certain substances catalysed the oxidation. These included nickel, iron oxide, calcium carbonate, calcium phosphate, and calcium sulphate. His experiments indicated why, in spite of the sulphitation of beet juices, syrups and molasses, there was so little sulphite in the molasses, since oxidation always occurred in the invariable presence of some of the catalysts included above.

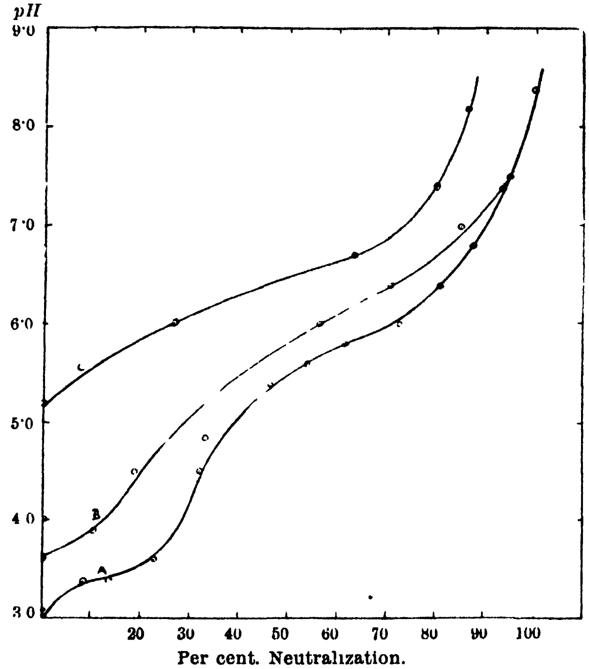

FIG. 2.

Neutralization of sulphurous acid by calcium hydroxide in the presence of Louisiana cane juice. After Brewster and Raines.

A. Juice sulphured to 10·25 c.c. acidity (*N*/10 per 10 c.c. juice)
B. Juice sulphured to 5·40 c.c. acidity (*N*/10 per 10 c.c. juice).
C. Juice not sulphured. Natural acidity = 1·5 c.c. *N*/10 per 10 c.c.

EXPERIMENTAL.

The precipitation of calcium sulphite was studied: (1) In the absence of sucrose; (2) in the presence of sucrose; and (3) in the presence of sucrose and cane colloids obtained from cane syrup and cane molasses.

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[1] *Chem. Soc. Trans.*, 1922, **121**, 1813. [2] *Compt. rend.*, 1915, **160**, 318.

Precipitation of Calcium Sulphite under Various Conditions.

The following factors were varied: (1) Time of precipitation; (2) temperature of precipitation; (3) extent of neutralization (reaction); and (4) initial concentration of sulphurous acid and of calcium hydroxide.

In the earlier experiments the concentration of the sulphurous acid was kept to approximately 0·5–0·7 grm. SO_2 per litre; in the later experiments the sulphurous acid was more concentrated, i.e., 1 to 2 grms. SO_2 per litre. To a given volume of sulphurous acid (generally 100 c.c.) was added a certain volume of either saturated lime water or normal calcium sucrate, and in addition sucrose, syrup or molasses when required. The solution contained in a conical flask was stirred for a given time interval in a thermostat. The stirrer passed through a rubber cork in the neck of the flask. The experiments at 90-100° C. were carried out on a gently boiling water bath, and a reflux condenser was fitted on to the flask. After the time interval had elapsed the precipitated calcium sulphite was filtered off, and the CaO, SO_2 and pH determined in aliquot portions of the filtrate.

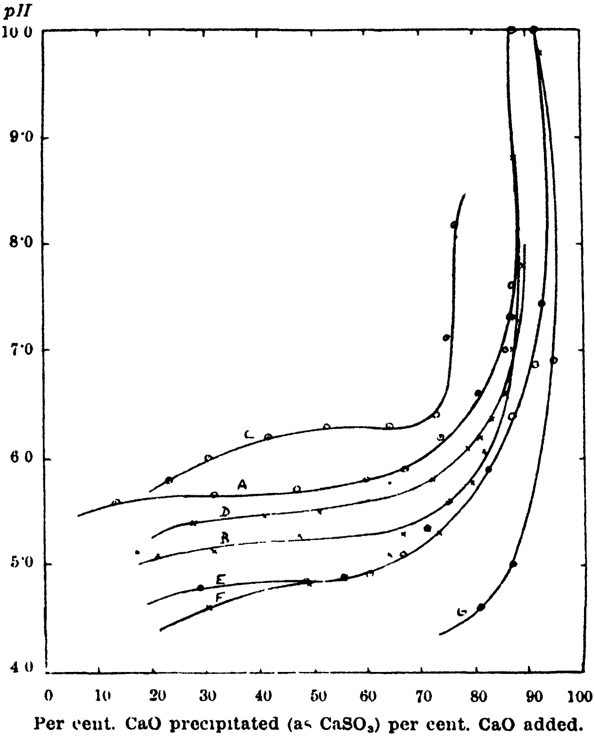

FIG. 3.

Precipitation of calcium sulphite from aqueous solution during the neutralization of sulphurous acid by calcium hydroxide.

Sulphurous acid 0·046 N. Calcium hydroxide 0·046 N.
Initial concentration of SO_2 = 0·5 g.p.l.

A. Solution maintained at 30° for 45 mins.
B. Solution maintained at 30° for 45 mins., then brought to boil and cooled.
C. Solution maintained at 30° for 15 mins.
D. Solution maintained at 30° for 15 mins., then brought to boil and cooled.
E. Solution maintained at 70° for 15 mins.
F. Solution maintained at 70° for 15 mins., then brought to boil and cooled.
G. Solution boiled, then maintained at 89-91° for 60 mins.
Initial concentration of SO_2 = 1 g.p.l.

Knowing the original amount of lime and sulphurous acid present, the percentage which had been precipitated was calculated. CaO was determined by precipitation as oxalate and subsequent permanganate titration ; SO_2 was determined by running an aliquot portion of the solution into an excess of iodine-potassium iodide and titrating back with sodium thiosulphate; whilst the *pH* was determined colorimetrically using the indicators of CLARK and LUBS and the buffers recommended by the same authors. The buffer standards were tested against the hydrogen electrode which itself could not be used for *pH* determination in the presence of sulphites, since these are active poisons. The same applies to the quinhydrone electrode.[1] A colour comparator was always used, and when dealing with coloured solutions compensation was made by the method of WALPOLE.

A.—NEUTRALIZATION OF SULPHUROUS ACID BY CALCIUM HYDROXIDE.

In order to obtain some preliminary idea of the neutralization of sulphurous acid, the neutralization curve (Fig. 1) was constructed representing *pH* and percentage neutralization of sulphurous acid. Known propoitions of equivalent solutions (0·046 *N*) of sulphurous acid and calcium hydroxide were mixed at 20°C. and after shaking for a minute the *pH* was determined. Curve *A* (Fig. 1) gives the neutralization curve at 20° C., and curve *B* represents the effect of bringing the solution to the boil and quickly cooling again. Directly 50 per cent. neutralization is exceeded, normal calcium sulphite is formed and precipitates. The end point is not reached until *pH* 9·2, indicating that calcium sulphite reacts alkaline. On the first portion of the curve, sulphurous acid-calcium bisulphite, the effect of boiling is to drive off some sulphurous acid and the *pH* rises. There is no sign of any decomposition of calcium bisulphite into calcium sulphite. On the second portion of the curve, calcium bisulphite-calcium sulphite, the effect of boiling is to precipitate the calcium sulphite, some of which, however, has already precipitated in the cold on mixing the solutions.

The *pH* of a solution of calcium bisulphite (0·023 *N*) is *pH* 4·8. Similarly the *pH* of a solution of calcium sulphite (0·005 *N*) is *pH* 9·2. During the period where the maximum precipitation of calcium sulphite occurs on boiling (from 55 per cent. to 80 per cent. neutralization) the *pH* keeps practically constant at about *pH* 5·2–5·3 ; in other words, there is a strong buffer action.

B.—PRECIPITATION OF CALCIUM SULPHITE FROM AQUEOUS SOLUTION.

After the neutralization curve had been found, the precipitation of calcium sulphite was determined at various temperatures, time intervals and percentage neutralizations as follows (see Fig. 3):—

Curve *A* Precipitation at 30° C. for 45 mins.
B ,, ,, ,, ,, ,, ,, then solution boiled and cooled.
C Precipitation at 30° C. for 15 mins.
D ,, ,, ,, ,, ,, ,, then solution boiled and cooled.
E Precipitation at 70° C. for 15 mins.
F ,, ,, ,, ,, ,, ,, then solution boiled and cooled.
G Precipitation at 90–100° C. for 60 mins.

(N.B.—The initial concentration of SO_2 in *A* to *F* was 0·5 grms. per litre; and in *G* 1 grm. per litre.)

Fig. 3 gives the relative amounts of precipitation at the different *pH*, i.e., CaO precipitated as $CaSO_3$ per cent. of the CaO originally added. Generally the maximum precipitation does not occur until the *pH* of the hot solution reaches 8, or over. The longer the time interval the more calcium sulphite precipitates.

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[1] FARNELL, *I.S.J.*, 1925, 27. 141.

Comparing the percentage precipitation for *A* and *B* it appears that no further precipitation occurs on bringing the solution up to the boil (in the absence of colloids). On boiling the solution first and then maintaining for one hour at 90-100°C. the maximum precipitation (94·6 per cent.) of all the series is attained, (*G*).

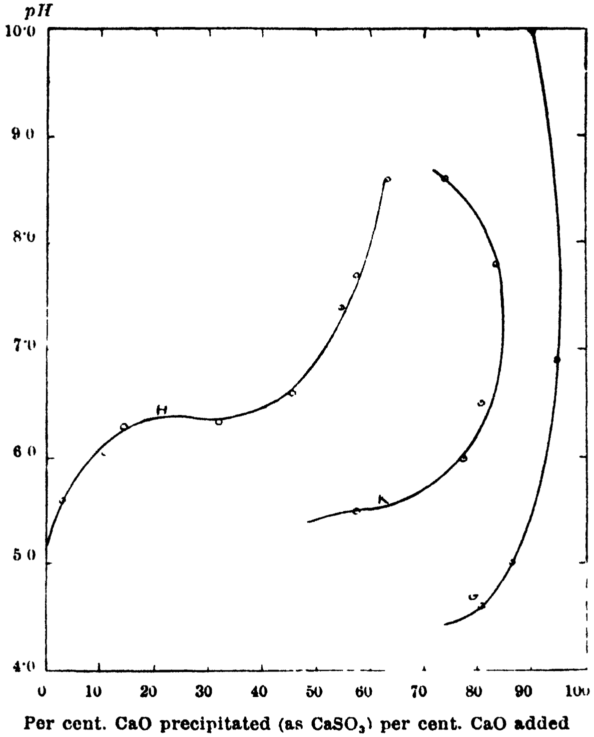


FIG 4.

Precipitation of calcium sulphite from diluted cane syrup during the neutralization of sulphurous acid by calcium hydroxide.

Syrup solution 15° Brix.

H. Solution boiled, then maintained at 80-91° for 60 mins. Initial concentration of SO_2=1·05 grms. per litre

K. Solution boiled, then maintained at 89-91° for 60 mins. Initial concentration of SO_2=1·95 grms. per litre.

G. Syrup absent. Aqueous solution boiled, then maintained at 89-91° for 60 mins. Initial concentration of SO_2=0·98 grm per litre.

C.—PRECIPITATION OF CALCIUM SULPHITE FROM SUCROSE SOLUTION.

Three series of experiments were run: 45 mins. at 30°C., 15 mins. at 30°C., and 15 mins. at 70°C. In all, the concentration of sucrose was 15 grms. per 100 c.c.

There is a slight delay in the precipitation at 30°C. In each case a further precipitate of calcium sulphite was obtained on boiling. At 70°C., however, the effect of sucrose seems quite negligible, and the precipitation is not retarded in any way.

The presence of sucrose greatly diminishes the size of the calcium sulphite crystals. The crystals, however, both in the absence and presence of sucrose show the very characteristic star-shaped clusters of crossed needles of $CaSO_3 . 2 H_2O$. Very different is the calcium sulphite when precipitated in the presence of colloids. (Compare photographs Nos. 1 and 2 with 3, 4, 5, 6.[1])

D.—PRECIPITATION OF CALCIUM SULPHITE IN CANE SYRUP AND CANE MOLASSES.

The syrup was diluted to 15° Brix, the precipitation therefore taking place from a solution closely approximating to cane juice. Owing to the much higher colloid content, the molasses was diluted to 1 per cent.

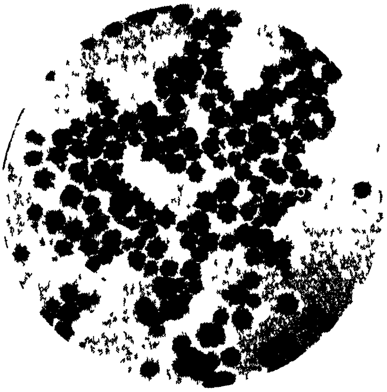
(1) *Precipitation from Diluted Cane Syrup.*

Solution maintained at 30°C. for 45 mins. then brought to boil (initial concentration of $SO_2 = 0{\cdot}5$ grm. per litre).

Solution maintained at 30°C. for 45 mins., then brought to boil (initial concentration of $SO_2 = 1$ grm. per litre).

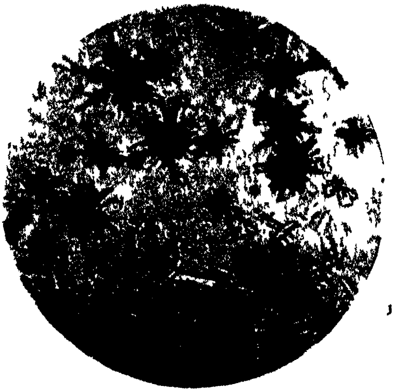
Solution boiled, then maintained at 90°C. for 60 mins. (initial concentration of $SO_2 = 0{\cdot}5$, 1, and 2 grms. per litre). See Fig. 4, curves *H* and *K*.

No precipitation occurs either at 30°C. or on raising to the boil when the initial concentration of SO_2 is only 0·5–0·6 grm. per litre; but there is some slight precipitation when the solution is first boiled and then maintained at 90°C. (i.e., 17 per cent. at *pH* 7·1 and 22 per cent. at *pH* 7·3). On increasing the SO_2 content to 1 grm. per litre, there is some slight precipitation after 45 mins. at 30°C. (i.e., 7 per cent. at *pH* 8·7) and on raising to the boil 48·4 per cent. precipitation occurs at *pH* 7·25, 57·4 per cent. at *pH* 7·8, and 55·2 per cent. at *pH* 8·4.



MICRO-PHOTO No 1.

Calcium sulphite precipitated from aqueous solution at 30°C *pH* 10. $SO_2 = 0{\cdot}75$ grm. per litre.



MICRO-PHOTO No. 2.

Calcium sulphite precipitated from aqueous solution at 70°C. *pH* 10 $SO_2 = 0{\cdot}74$ grm per litre.

It appears that the initial concentration of sulphurous acid is largely responsible in determining the extent of calcium sulphite precipitated. A maximum precipitation of 21·6 per cent. occurs at a concentration of SO_2 of 0·5 grm. per litre, 63·5 per cent. at 1 grm. per litre, and 83·6 per cent. at 2 grms. per litre, the solution in each case being maintained at 90°C. for one hour.

With low concentrations of SO_2, maximum precipitation of calcium sulphite does not occur until the hydrogen-ion concentration of the hot solution exceeds *pH* 8. But when the concentration of SO_2 is increased, the maximum precipitation may occur below *pH* 8.

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[1] All magnified X 18

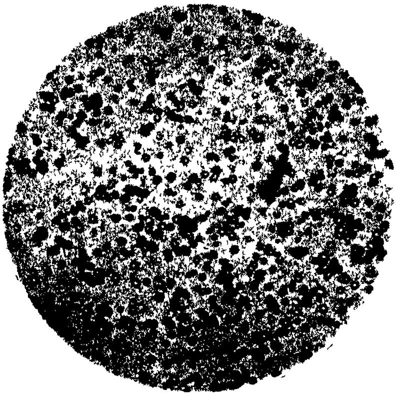
(2) *Precipitation from Diluted Cane Molasses.*

Solution maintained at 30°C. for 45 mins. then brought to boil (initial SO_2 concentration of 0·7 grm. per litre).

Solution maintained at 70°C. for 15 mins., then brought to boil (initial SO_2 concentration 0·7 grm. per litre).

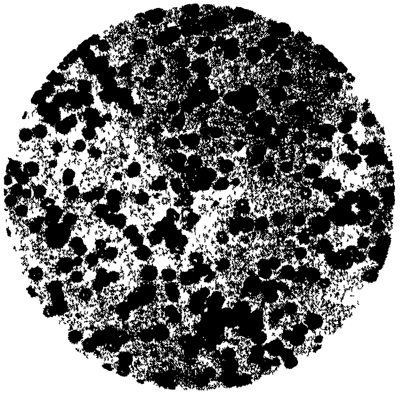
Solution boiled, then maintained at 90°C. for 60 mins. (initial SO_2 concentration 0·7 and 1 grm. per litre).

Very similar results are obtained to those of the syrup experiments. No precipitation occurs when the solution is maintained at 30°C. for 45 mins.; but on afterwards boiling there is a considerable precipitation, a maximum of 44·6 per cent. being attained at *pH* 7·8. At 70°C. no precipitation occurs until the *pH* exceeds 7·25; after this there is some precipitation with a maximum of 45·3 per cent. at *pH* 7·8. On boiling, however, further precipitation occurs in all cases where the *pH* exceeds 6·75. On boiling and maintaining the solution for one hour at 90°C., a maximum precipitation of 68·1 per cent. occurs at an initial concentration of 0·7 grm. per litre, and a maximum of 84·1 per cent. at 1 grm. SO_2 per litre, the respective hydrogen-ion concentrations being *pH* 8·5 and 8·5.



Micro-Photo No. 3

Calcium sulphite precipitated from diluted cane syrup (15° Brix) at 90°C. *pH* 5·9 SO_2 = 1·95 grms. per litre.



Micro-Photo No. 4.

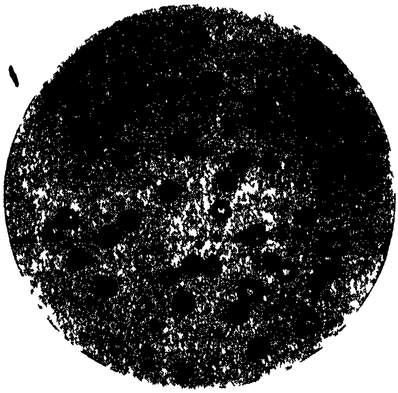
Calcium sulphite precipitated from diluted cane syrup (15° Brix) at 90°C. *pH* 6·5. SO_2 = 1·95 grms. per litre.

The results of the various experiments recorded above show that among the factors determining the precipitation of calcium sulphite, the following are the most important:—(*a*) Extent of neutralization of sulphurous acid; (*b*) time and temperature; (*c*) presence or absence of colloids; and the (*d*) initial concentration of sulphurous acid and calcium hydroxide.

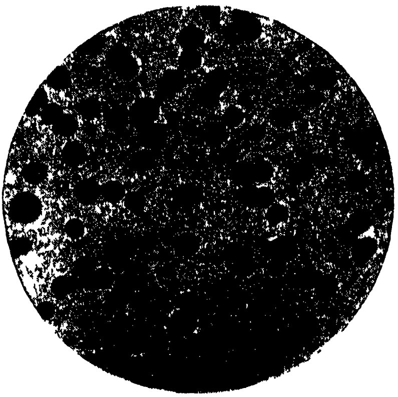
Complete neutralization of sulphurous acid, high temperature, and adequate time for precipitation, the absence of colloids, and a high initial concentration of sulphurous acid are all favourable to the precipitation of calcium sulphite.

E.—Character of Calcium Sulphite precipitated in the Presence of Colloids.

The calcium sulphite precipitated in the presence of colloids was in the form of apparent spheres, in which a nucleus was sometimes visible, especially in the case of the molasses experiments. Contrast with the well defined needles of $CaSO_3$ $2H_2O$ obtained by precipitation from aqueous and sucrose solution is very marked (compare photographs 1 and 2 with 3, 4, 5, and 6); the size of the spherical globules increases with rising *pH* (3, 4, 5, and 6); while also the higher the initial concentration of sulphurous acid the larger the particles of precipitated calcium sulphite. Naturally the longer the time for growth and the higher the temperature the larger and better formed are the grains (1 and 2).[1] The effect of colloids of the emulsoid class on altering the nature of inorganic precipitates is well known. The precipitation of calcium sulphite furnishes another instance of the important effect of colloids on the manufacture of cane sugar which has frequently been insisted on.



MICRO-PHOTO No. 5.
Calcium sulphite precipitated from diluted cane syrup (15° Brix) at 90°C. *pH* 7·8.
SO_2 = 1 95 grms. per litre.



MICRO-PHOTO No. 6.
Calcium sulphite precipitated from diluted cane syrup (15° Brix) at 90°C. *pH* 8·6.
SO_2 = 1·95 grms. per litre.

F.—APPLICATION OF RESULTS TO SUGAR FACTORY PRACTICE.

It appears that an initial SO_2 concentration of 0·5 grms. litre is the minimum necessary to insure precipitation of calcium sulphite on liming the juice, heating to 100° C., and settling for at least one hour in tanks. The maximum precipitation under different conditions is given in the following table:—

Initial conc, grms. SO_2 per litre.		*pH* of hot juice for maximum precipitation. per cent.		Maximum precipitation after 60 mins at 90° C. per cent.		Precipitation at *pH* 6·8 on hot juice. per cent.
0·64 (molasses	..	8·6	..	68·1	..	about 57
1·02 experiments)	..	8·6-8·5	..	84·1	..	76
1·05 (syrup	..	8·6	..	63·5	..	48
1·95 experiments)	..	7·8	..	83·6	..	82

Column (3) shows the maximum precipitation at the *pH* record in column (2), and columm (4) shows the precipitation which occurs when the hydrogen-ion concentration of the hot juice is *pH* 6·8, a figure common in white sugar factories of Natal and Mauritius. It will be seen that the precipitation at *pH* 6·8 is never so great as the maximum, but that it more nearly approaches the maximum the more highly the initial sulphuring of the juice.

Generally speaking, the sulphite scaling is more serious in Mauritius than in Natal, although a more intense sulphuring is practised in Natal (1·5–2·5 grms. SO_2 per litre) than in Mauritius (0·8-1·0 grms. SO_2 per litre). In both countries the hydrogen-ion concentration of the clarified juice is around *pH* 6·9-7·0. But at a given *pH* on the hot juice there is a greater percentage precipitation of calcium sulphite at an initial SO_2 concentration of 2 grms. per litre than at 1 grm. per litre, so that conditions in Natal more nearly approach the optimum than in Mauritius.

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[1] *cf.* STOCKS, *J. Soc. Chem Ind.*, 1912, 21, 527. [2] FARNELL, *I.S.J.*, 1924, 26, 359, 420, 480; 1925, 27, 254.

Neutralization curves of sulphured Louisiana cane juices have been constructed (see Fig. 2) from data recorded by BREWSTER and RAINES (*loc. cit.*).

Juice *A* was sulphured to 10·25 c.c. acidity, corresponding to about 2·8 grms. SO_2 per litre; juice *B* was only sulphured to 5·4 c.c. acidity (1·25 grm. SO_2 per litre); juice *C* was not sulphured at all; its initial acidity was 1·5 c.c. Lime was added to all the juices, and after each addition the *pH* was determined; in other words this was the neutralization curve of H_2SO_3-$Ca(OH)_2$ in the presence of cane juice. Fig. 2 shows that there is a greater sulphite buffering in juice *A* than in juice *B*, and that a given percentage neutralization (and percentage precipitation) is reached at a lower *pH* in juice *A* than in juice *B*, thus confirming the experiments recorded in this paper, showing that the higher the juice is sulphured the greater is the percentage precipitation of calcium sulphite at any given *pH* on the clarified juice.

It is suggested that to precipitate calcium sulphite more completely, the *pH* of the hot juice should in many cases be increased from *pH* 6·8 (average practice in Natal and Mauritius) to *pH* 7·6–7·8. In Mauritius the filter-press area would, however, have to be increased.

World Molasses Supply and Trade.[1]

The value of molasses for mixing with cattle feedstuffs and, more recently and of even greater importance, as a raw material for the production of alcohol, has brought to this commodity, once generally regarded as a waste product and largely used as fuel for sugar mills, a commercial importance which has greatly enhanced prices and caused a scouring of the world's production areas to augment available supplies.

Nowhere has the industrial alcohol industry shown a more impressive expansion than in the United States, where the records show 71 plants producing 87,455,535 wine gallons of alcohol during 1924-25, as against 8 plants with an output of 1,780,276 gallons in 1906-07. Blackstrap, or "final" molasses, is a cheap and most acceptable raw material. About 2¼ gallons are required to produce 1 gallon of 95 per cent. (100 proof) alcohol, but the actual yield has been established at about 90 per cent. of this theoretical ratio. Small quantities of beet molasses have been used for the production of alcohol, but the amount so used has decreased during the past few years and is now negligible. Beet molasses is used mainly as cattle feed.

The apparent molasses consumption of the United States in 1924 was approximately 228,160,499 gallons compared with 236,996,874 in 1923 and 144,976,622 gallons in 1922. Definite figures for the total quantities of beet and cane molasses making up these total supplies are difficult to ascertain because separate classifications are not given to these two varieties in U.S. imports from some foreign countries. The vast bulk of imported molasses is, however, derived from cane, though a considerable quantity of beet molasses came from the Netherlands during 1924.

United States production of beet molasses for 1924, 1923, and 1922 was, respectively, 19,426,000, 17,966,587, and 26,944,467 gallons. Ninety-five per cent. of the cane molasses produced in the United States comes from Louisiana, which turned out 21,850,846 gallons in 1922, 16,578,476 in 1923, and only 9,589,544 gallons in 1924. This decrease for Louisiana is accounted for by a correspondingly increased syrup production, which attained record proportions in 1924.

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[1] Prepared by the Foodstuffs Division of the American Department of Commerce, and reproduced (in abridged form) from *Commerce Reports*.

Imports of molasses into the United States for 1913 and 1921-24, inclusive, were as follows:—1913, 51,200,000 gallons; 1921, 101,733,000 gallons; 1922, 118,242,000 gallons; 1923, 206,012,000 gallons; and 1924, 200,546,000 gallons.

Aside from the remarkable increase in volume of imports from 1913 to 1924, the most pronounced change is found in the greater number of sources drawn on by American importers during the latter year, indicating that the demand from the United States has definitely outgrown the present available supplies of Cuba, practically its sole source of supply in 1913. While Cuba remains—and no doubt will always be—the principal source of molasses, other Carribbean countries (particularly the Dominican Republic, Trinidad, and Tobago), as well as Canada, England, the Netherlands, and British South Africa are now contributing important quantities to the United States.

Despite Cuba's large sugar production of 1924, molasses exports from that country to the United States declined by 11,401,029 gallons from the 1923 shipments. This is partly accounted for by efforts to develop the motor alcohol industry in Cuba, with consequent retention for domestic use of increasing quantities of molasses, and also by the practice of more and more intensive sugar recovery methods, with correspondingly less molasses being made by the sugar mills. Cuban production figures are not available, but, using the equation 7 gallons of molasses to each bag of 320 lbs. of sugar produced, the following approximations of molasses production are derived:—

	GALLONS
1922	196,000,000
1923	176,000,000
1924	198,000,000
1925	285,000,000

Prior to 1924 Cuba always had a surplus for export to foreign countries other than the United States after satisfying the American and Cuban demand. In 1924, however, the United States took practically the entire quantity available for export and the Cuban consumers were at the same time complaining that insufficient amounts were retained for their use, obliging them to advance prices for their alcohol to a point where it could not compete with gasoline as a motor fuel.

Because of the growing world demand, the molasses supply of far-off Java and Madura is attracting much attention. Ranking next to Cuba as a producer, the exportable surplus of these islands is being eagerly sought after, with the natural result that prices advanced sharply in 1924.

The total possible production of hard and liquid molasses in the Dutch East Indies has been estimated at 123,600,000 gallons, on the basis of a recovery of 282 gallons from each acre planted to sugar cane. The total actual production is the subject of widely varying estimates by Java dealers, the consensus of which indicates an annual outturn of 91,000,000 to 101,000,000 gallons. Of this, the amount finding its way into commercial channels is placed at about 61,000,000 gallons, which is mostly that produced close to seaports or in mills possessed of transportation facilities. The difference is the product of interior mills, much of it being burned as fuel, and the rest disposed of to domestic alcohol manufacturers.

The exportable surplus, according to information received in the Department of Commerce, is largely in the hands of one foreign company, only about 1,000,000 gallons being procurable from independent sources in 1924. Dutch East Indian molasses is shipped, under normal conditions, principally to India, Hongkong, and Malayan ports. Important quantities were moving to England and the United States during the early part of 1925.

Much of the Dutch East Indian molasses shipped to India and other near-by points is hard, or solidified. Solidification is accomplished by evaporation of moisture, using a vacuum pan process. After processing, the mass is poured while hot into bamboo and rattan containers, to which it adheres on cooling, and in this fashion is transported as ordinary freight.

Publications Received.

Schlomann-Oldenbourg Illustrated Technical Dictionaries. Alfred Schlomann, Editor-in-Chief; and H. I. Lewenz, M.I. Mech. E., M.I.E.E., Editor of the British Sections. (Lewenz and Wilkinson, Ltd., London.)

These dictionaries are of great value, in fact one may rightly say indispensable, to the reader of foreign technical literature. They are published in English, French, German, Italian, Russian, and Spanish, and are designed to cover most branches of engineering and technology, one volume being devoted to each subject. Volume I deals with Machine Components and Tools; II, with Electrical Engineering; III, with Steam Boilers, Engines and Turbines; IV, with Internal Combustion Engines; V, with Railway Construction; VI, with Railway Rolling Stock; VII, Hoisting and Conveying Machinery; VIII, with Reinforced Concrete; IX, with Machine Tools; X, with Motor Cars; and so on to Volume XV on Spinning, the latest to appear, yet others being in course of preparation. The publication of these dictionaries must have proved a gigantic undertaking, and must have entailed an immense amount of labour in the collection and checking of the vocabularies of specialists, operators, and workmen in the six languages of so many different branches. In effecting this compilation, blank books were provided for each heading, and sketches, symbols and formulae. Contributors took these books and visited factories, mills and laboratories, talked with engineers, mechanics and others, obtaining from these various sources correct technical terms for items contained in the books, as well as new terms and sketches on the same subject. The system of indexing the words for ready reference leaves nothing to be desired; whilst a notable feature is the very numerous small and neat illustrations of machines, parts, tools, accessories depicted in the central column of each page with the vocabulary relating to them on either side, this indeed constituting a seventh, universally understood language. We highly recommend these volumes to all reading foreign technical literature. They go very far beyond anything else attempted in the way of international technical dictionaries, and one or other of the volumes should be in the library of every engineer.

Emploi de la Vapeur dans la Fabrication du Sucre. By Karl Abraham. French edition translated from the second German edition by Em. Légier. 1925. Price: 15 francs.

Abraham's "Dampfwirtschaft" is here available in French with notes by Em. Légier. It is a work too well known and appreciated to require any description or recommendation here.

"Carboraffin" in the Sugar Industry. (Manufacturers: United Chemical and Metallurgical Works, Limited, Karlsbad; Sole Agents for the U K.: Bush Beach and Gent, Ltd., 24, Monument Street, London, E C. 3; Technical Adviser: Mr Chas. Ferguson, F.C.S., 19, Craven Street, W.C. 2).

"Carboraffin" is a very powerful decolorizing carbon, which is used quite largely on the Continent without revivification, and is a preparation of considerable interest. Having achieved a success in beet sugar manufacture, steps are now being made to introduce it to cane sugar manufacturers and refiners, and four attractively printed booklets in English are now available. The first compares "Carboraffin" and bone charcoal, and points out *inter alia* that only one-eightieth of the former is required to give the same result as the latter, with a considerable simplification of operation and plant as well. The second discusses the properties of this carbon, and details examples of its application, it being mentioned here that when operating in the white beet factory according to a certain scheme the consumption works out only at 0·022 per cent. of the white sugar produced; or to only 0·071 per cent. in refinery operation. The third booklet gives general directions for use, treating of the method of "layer filtration" used for this carbon with good results, and dealing with details of the operation of certain Continental beet factories and refineries. The fourth describes the "stirring in method," that is, the procedure in which the carbon is mixed with the juice and the mixture filtered, instead of passing the syrup through a layer of carbon deposited on the cloth. These four booklets make interesting reading, and should be in the possession of all concerned with white sugar production.

Trade Notices.

From Messrs. BLAIR, CAMPBELL & McLEAN, Ltd., of Govan, Glasgow, we have received particulars of an improved form of Lubricator for mill roller journals which they have designed. The conditions attached to a good lubricator of this nature are that it should be capable of handling either thin or thick oil, or grease, as may be desired; that it should allow the lubricant to be forced under pressure through the bearings; and that any wearing parts should be easily replaceable. The B.C.M. Lubricator is designed to fulfil these requirements. It is not however automatic, but requires to be screwed down at intervals by the attendant. This firm have also studied the lubrication problem further than the actual lubricator and have devised a system of oil gutters which in conjunction with their Lubricator is claimed to be a decided improvement. Full particulars can be obtained from Messrs. BLAIR, CAMPBELL & McLEAN.

The AMERICAN HOIST AND DERRICK Co., of St. Paul, Minnesota, has recently redesigned its motor-driven stationary hoist, changing it from chain drive to gear drive. Spur and bevel gears are used with an intermediate longitudinal shaft placed at right angles to the pinion shaft which is the crank shaft of a steam hoist, the gasoline motor being mounted lengthwise instead of crosswise on the hoist. The substitution of gear drive gives a number of important advantages, amongst which are speedier shipment of both hoist and driving mechanism, and ability to change the line speed to meet varying requirements without seriously delaying shipment. The principal advantage as compared with the old chain drive is, however, that power is transmitted by at least two teeth—one to each adjoining friction gear—whereas under the older system the strain was borne by only one gear tooth. Incidentally, gasoline hoists have advantages over the steam and electric power units; they can be used where electric power is not available, where the water supply is unsuitable for steam boilers or where there is no boiler water at all, and they can be used in and around buildings where steam boilers are not allowed. Nor do they require a licensed engineer. Further details as to the working of this new geared hoist can be obtained from the makers.

As the result of three years of intensive study, supplemented by the advice of some of the best sugar mill operating engineers, the FARREL FOUNDRY & MACHINE COMPANY, of Ansonia, Connecticut, is about to put on the market a new Gear and Motor Drive for operating cane mills, which is being covered by patents. This new drive is claimed to take up less space than any existing drive, and to deliver to the mill 95 per cent. of the power generated by the motor (as against approximately 75 per cent. in existing drives); it puts the control of the starting and stopping of the entire mill train under one operator, which permits the latter to give any speed variation desired to any milling unit, independently of the others, this entire control being located at one point if desired. The gear train is entirely enclosed, dust-proof, and self-oiling; and it is said to be as nearly noiseless as it is possible to make steel gearing. Journal boxes are fixed in position in the bedplate at the point of manufacture, and require no adjustment in the field. Foundations are smaller, and no complicated frame work is required for constructing them. Plantation owners and engineers who are interested in this drive can obtain additional information direct from the FARREL Co. or through any of their branch offices.

Brevities.

J. C. L. Defize[1] points out that when condensed water which is to be examined for traces of sucrose is filtered through cheap, insufficiently washed filter-paper it may give a positive naphthol reaction as the result of the solution of reacting substances in the paper.

The possibilities of "Celotex" production in Java are about to be investigated, Dr. Ph. van Harreveld[2] announces. Present price for the imported material is 2·25 Dutch florins, a figure which should be considerably lowered when factories co-operate in manufacturing it.

A paper was recently read by Dr. G. N. White and Mr. C. J. Goodwin before the South Wales Institute of Engineers on the subject of briquetting fine coal and anthracite, using pulp binders, prepared by a special process[3] from vegetation consisting of grass, straw, cactus, bagasse, banana leaves, and various other wastes, including exhausted beet slices. Briquettes made by this process are stated to withstand severe climatic conditions without deterioration, and the chief field of application of such pulp binders is said to be in connexion with the economic development of colonial and foreign fuel resources.

Problems suggested by M. Thiel[4] for solution in the beet sugar industry include the following :—Whether the diffusion vessels should be heat insulated; whether parts of apparatus with which sulphurous acid comes into contact should be constructed of resistant material; the cause of the discoloration of juice during evaporation; the question of the extent of the loss of sucrose by entrainment from the several effects of the evaporator and from the pans and the prevention of this loss; and lastly whether the vapour evolved from sugar solutions has the same temperature as the solution or acquires that of saturated steam.

Dr. Ph. van Harreveld[5] in a short report on the measurement of boiler feed-water mentions that the Schmid apparatus is in use in 17 factories in Java; the Meinecke in 29; the Eckhardt in three; the Kennedy in two; and the Siemens & Halske in one only. He appears to think highly of the apparatus invented by N. Nobel, which is said to be "entirely reliable," this being of the type comprising an iron measuring tank with overflow which is filled and emptied through bronze automatic valves, a counter indicating the number of fillings One of these apparatus is installed in the Pandaan sugar factory, Java, where till now it has given the most satisfactory results.[6]

A process for the production of sulphuric acid from gypsum, as operated at the Leverkusen plant of Bayer & Co, was recently described.[7] When war broke out, and supplies of pyrites were excluded from that country, attention was directed by German chemists to the considerable local resources in the form of deposits of gypsum. As now elaborated, the process consists in the admixture of the mineral named with suitable quantities of coal or coke, the combustion of the mixture in revolving furnaces, and the utilization of the sulphurous acid for the production of the acid, the residue being a good quality Portland cement clinker. Ammonium sulphate was manufactured at the Oppau and Leuna plants of the Badische A. & S. F., by the reaction between gypsum and ammonium carbonate.

What is described by H. B. Ross[8] as a new variety of cane indigenous to the P.I. is now being propagated at Santa Monica. It apparently was brought down from the Zambales Mountains by the Negritos several years ago and it has been named "Hind's Special," in honour of Mr. R. Renton Hind. It is a long slender cane of a light purple colour when young, gradually turning a yellowish green when approaching maturity, and is a very rapid grower, quickly outstripping any other variety, even the famed Toledo. It is apparently immune to mosaic, and the very common smut disease. It is easily propagated; is highly resistant to drought; a good stooler; and, like the Toledo, it improves with each ratooning. A heavier cane than the Toledo, it does well on poor sandy soils. Its fibre content runs as high as 16·26 per cent.

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[1] *Chemiker Weekblad*, 1924, **22**, 467-468. [2] *Archief*, 1925, **33**, 799-800. [3] U.K. Patent, 226.344.
[4] *Centr. Zuckerind.*, 1925. **33**, 1200-1201.
[5] Director of the Java Sugar Experiment Station, in *Korte Mededeelingen* No. 53.
[6] *Archief*. 1925, **33**, No. 38. 967-969
[7] *Chemical Trade Journal*, 1924, **77**, No. 2000, 326. [8] *Sugar News*, 1925, **6** No. 10, 599-601.

At a meeting of the Trent Fishery Board at Derby recently, consideration was given to the effect of the effluent from sugar beet factories on fish life. A representative of the Ministry of Agriculture and Fisheries, stated that at the present moment they were not in a position to say whether the effluent was or was not detrimental.

Amongst companies recently registered are: Irish Sugar Manufacturing Company, Ltd., 39-41, Dame Street, Dublin; Sugar manufacturers, etc. Nominal capital £400,000 in 380,000 "A" shares of £1 and 400,000 "B" shares of 1s each. British Beet Syndicate, Ltd., 26, Victoria Street, S.W. (Reg. No. 210,480); Private. Nominal capital £1000 in £1 shares.

A gravity recording apparatus for liquids is now on the market having an accuracy of 0·00008 specific gravity or 0·02° Brix. It operates on the same principle as does the Westphal balance, that is, it depends on the variation in weight of a displacer suspended in the liquid with the variation in the gravity of the liquid, the rise and fall of the displacer being capable of automatic indication by a recorder pen on a chart plate. This apparatus is of value especially to show the gravity of the syrup leaving the evaporators, of liquors going over or coming off char in the refinery, of sweet-waters, and of alcohol in the distillery.

Experiments have been carried out during the past five years in Louisiana on beet cultivation, and the roots harvested have never contained less than 12·5 per cent. of sucrose with a purity of 84°, nor has the tonnage ever been less than 15, having been generally between 20 and 25. It has therefore been decided[1] to install a diffusion battery and carbonation plant in the sugar-house of the Experiment Station, in order to manufacture sugar at the rate of 50 tons per day from roots grown in the State. This large-scale experiment is expected to demonstrate the practicability of the beet industry in this part of the U.S.A.

"Sugar beet culture is not especially difficult. But it is exacting and requires something more than seeding, irrigating and reaping.[2] . . . . . Only the man with the hoe is responsible if his beet acres fail to yield a profit. . . . . Economically, then, there is nothing against the beet. It is a money-maker of itself, it provides valuable products, and long experience has demonstrated that maximum beet crops leave the lands richer and better than the seeds found it. The path to farming independence is paved with just such crops as sugar beets. If you want a cash bank balance, sugar beets provide a stepping-stone."

Caramel is used in certain countries for tinting up raw sugar to confirm to a certain D.S.; but, whether it be prepared over an open fire, or whether by steam heating, a very fine black precipitate forms. This insoluble matter collects on the outer layer of sugar in the centrifugals, subsequently causing the caking of the surrounding crystals. It can of course be filtered off, but A. PRINS[3] recommends that the solution of caramel should previous to use be centrifuged through a layer of sugar crystals, a method that is very rapid, and convenient for dealing with a large volume of the liquid at one time. When the sugar acting as filter, has been dissolved, it is easy to remove the layer of scum remaining, and commence the spinning operations again.

Calculating in the manner recently described,[4] Mr. E. SAILLARD estimates[5] the sugar production in France to amount to 635,295 tons. His estimate for the crop of 1924-25 was 742,000, whilst the actual amount obtained was 740,000 tons. In France the average sucrose content in the roots (hot digestion method) during the past five years has been 16·03, 16·74, 17·05, 16·32 and 15·58 per cent; and the apparent purity 85·99, 87·6, 87·1, 87·5, and 85·0°. He has conducted field tests[6] with roots raised from French and foreign seed, finding 16·09 per cent of sucrose, 87·21 grms. sucrose in a single root and 86·0° purity for the first, and 15·81 per cent., 76·29 grms. and 85·3° respectively in the second. It would appear from his findings that French seed was superior to the imported (names of the varieties not given).

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[1] Sugar Beet Circulars, Nos. 1 and 2, Louisiana State University Extension Service.
[2] *Caldwell Tribune*, Idaho, U.S.A. [3] *Archief*, 1925, 33, No. 36, 910. [4] *I.S.J.*, 1924, 608.
[5] *Supplement à la Circulaire hebdomadaire du Comité Central des Fabricants de France*, No. 1906. *Ibid.*, No. 1905.

Review of Current Technical Literature.[1]

Falkiner Cane Harvester. *R. S. Falkiner. The Australian Sugar Journal, 1925, 17, No. 7, 453-457.*

What is believed to be a very interesting development in cane harvester construction was demonstrated recently at Qunaba, Queensland. It is the result of the gradual evolution of a principle originated in 1908, and upon it the inventor has spent many thousands of pounds. The cane is gathered between the two arms shown in front of the machine, and when well back on to the elevator it comes in contact with the revolving knives and is cut. It is then elevated through the pneumatic throwing rollers, which, revolving at high-speed, seize the top, and the cane is fired through against the baffle board with the velocity of an arrow from the bow. The long leaves on the head of the cane are carried forward and upwards in advance of the stalk as it flies, by a powerful air-blast, through six independent nozzles, which hold the leaves firmly against the slatted belt, which is rotated overhead at high-speed, all loose trash and ash being blown off the stalk through the slats. This action was very noticeable during the demonstration, one of the spectators describing the cloud of debris as resembling that hovering above a cane fire.

The head of the stalk strikes the baffle board situated at a convenient distance behind the topping knives, which are circular in shape and rotate inwards, and overlapping about half an inch, so that the heads of the cane, when passing through, are cleanly cut. What are termed the discharging rollers are another set of pneumatic rollers about 20 ins. in diam., and separated to allow the air-blast to pass between them. These are placed parallel with, and close up to, the projected cane from the throwing rollers. Thus, as soon as the head of the cane strikes the baffle board and drops an inch or two, it is seized by these rollers and passed through the knives in a parallel position. These knives decapitate the head, and discharge the tops out of the back of the machine and the stalks into the hopper for that purpose below. The place of discharge of the topped cane from the rollers being about 8 ft. above, it may be found convenient to draw a truck, or series of trucks, alongside the cutting apparatus to receive the cane, thus obviating the necessity of picking up from the ground after it has been cut and topped. The machine is propelled and operated by two 20 h.p. Austin kerosene tractor engines. The type of track used has rounded edges and interlocking treads, with smooth round edges specially designed so that in short turns they do not tear up the ground, nor root out the stools of cut cane, as has been the experience with square treads of the caterpillar type. The front wheels are used for steering, and are of the ordinary tractor type, having a fairly wide face and a fin down the centre which operates on the ground much in the same way as the keel of a boat in the water. The total weight of the machine is about five tons, but owing to the large dimensions of the tracks, the machine is very light-footed as regards lbs. pressure per square inch on the ground. As to the costs of working, it was found that the normal consumption is half-a-pint of kerosene per horse-power per hour, running full load, and owing to the special attention given to reduction of friction, the amount of oil and grease required is said to be very light. It has been estimated on the basis of recent trials that in an 11-ton crop the machine has been cutting and topping at the rate of 20 tons per hour. In a 20-ton crop this rate was increased to 40 tons, as the rate of travel is but little less than with the lighter crop. The whole operation was carried on by one man, and the fuel cost per hour should be (with kerosene at 2s. per gallon) for fuel, oil, and grease, say 6s.; plus the man's time, say 5s. per hour. It is not claimed that the machine, as developed, will be suitable for all cane; but it can deal with straight, upright cane when the trash is burned off. It is considered that 50 to 75 per cent. of the Australian crop of, say, four million tons of cane is straight enough and on suitable enough ground for this machine to operate, and with mechanical loading the present costs of 8s. per ton can easily be reduced to 2s., or less. This would mean (taking only 50 per cent. of the crop), a saving £600,000 per annum. The problem of dealing with green cane and trash is still engaging the attention of the inventor.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

JUICE HEATING, UTILIZING FLUE GAS WASTE HEAT. *J. O. Frazier. West India Committee Circular, 1925, 40, 883-885.*

Generally the waste heat in the flue gases of the cane sugar factory amount to 25 to 35 per cent. of the calories generated in the bagasse furnace; but so far its utilization for raising the temperature of the juice does not appear to have been worked out as a practical proposition, though in the case of factories running on extra fuel the advantage in so doing is at once apparent. Possibly this delay may have been due to fear of injuring the juice in the absence of apparatus in which the control of the temperature is ensured; and, anyway, it is necessary that the juice should circulate at the high speed of 350 to 600 ft per min., so as to secure a scouring action and the highest heat transmission. In an installation of the Frazier "by-passed flue gas juice heater," rated for a cane factory running at 300 short tons of cane per day,[1] there were 12 sections each with 32—1 in. × 6 ft. copper tubes expanded into suitable return headers or manifolds, the course of the juice being opposite to that of the gas travel. Juice was pumped through 8 passes of 4 tubes each in each section, then directed to the succeeding section. The pressure at inlet was 85 lb.; but at outlet, zero. The juice pressure acted against a brass piston in a brass cylinder coupled with suitable levers by which, while the juice was flowing, the blower engine valve was opened, the blower moving and the gases switched by suitable dampers from their normal path through the heater. Cessation of juice flow, accidentally or by design, destroyed the pressure, and counterweights caused opposite movements of damper levers, stopped the blower and engine, and switched the gases back to their chimney path. Between each two tube sections was installed a perforated gas pipe blast frame capable of traversing the tube length in close contact, by which a steam blast easily removed the ash from the smooth copper surfaces. Horizontal position of tubes was chosen for readier inspection. Small chamber plates covered two passes, the removal of which at opposite ends and the aid of a light at one end, made the entire tube interior visible. From a mill grinding 600 short tons of cane per 24 hours, 58 galls. per min. were uniformly taken. Inlet gases, by recording gauge, averaged 400° F., and outlet 250° F, inlet juice was 60° F., and outlet 155°F., a temperature rise of 95°F. There were 384—1 in. (o.d.) copper tubes 5 ft. 10 in. net length and 584 sq. ft. of heating surface. This showed 480 lbs. juice per min. raised 95°, and a heat recovery of 2,736,000 heat units per hour, which divided among 584 sq ft. of surface gave a heat transfer rate of 4648 heat units per sq ft. per hour. Velocity of juice flow was 473 ft. per min., path length 650 ft., and exposure time approximately 1¼ min. Mill bagasse ran at 53 per cent. moisture; hence 53 lbs. of moisture in the gases to each 100 lb. of bagasse as fired. This, in latent heat of vaporization—only recoverable by condensation—delivered 51,000 heat units with the gases to each 100 lb. of bagasse, to say nothing of that in the legitimate dry gases and in superheat of moisture not taken by the boilers. The large stream of condensation coming from the bottom of heater casing gave evidence of large recovery from the latent heat. So abundant was the condensation that it substantially washed clean the copper tubing in the cooler half of the heater sections. Broadly speaking, the experiments indicate the best balance of proportions in such apparatus to be 2 sq. ft. of heating surface per short ton of cane per 24 hours—so as to raise the factory juice equivalent from 80° F. to 212° F. Equally, that the maximum moisture condensation may be infinitely more profitable than primary temperature adaptation for its avoidance.

SYNTHETIC MOTOR FUELS. *Rex Furness. The Industrial Chemist, 1925, 1, No. 10, 475-480.*

This is an article which should be read by those who are interested in the production of motor fuels containing alcohol as it gives probable cost figures, and discusses the possibility of new liquid fuels, though here space can be found only for the following extracts: "There is little doubt that fermentation alcohol could be produced in enormous amounts, if necessary, at a price not too far removed from that of petrol, although many problems of production, transport, economics, law and ethics would demand prior solution. On the other hand, there are possibilities in at least one synthetic process of producing a liquid fuel in sufficient quantities from non-foodstuff materials and at a cost which would allow immediate competition with petrol. . . . . If cellulose materials could be saccharified by a cheap biological process, immense quantities of tropical vegetation, wood waste and so forth would become available for ultimate conversion into a power spirit. At the moment, however, any consideration of these facts must be set aside and we must concentrate upon the cost factor. With petrol at its present price in this country, it is clear that the value of this standard fuel at the refinery cannot exceed about 9d. per gall., and this is probably a high figure. Now the most careful estimates of the cost of producing alcohol from molasses upon a very large scale, no account being taken of the cost of the raw material—molasses—have placed these at 7d. per gall , so that 2d. per gall. is all that remains for the purchase, transport and storage of the raw material required, if alcohol is to be produced at a competitive cost, even allowing that a gallon of alcohol will do as much work in the internal-combustion engine as a gallon of petrol, an assumption which favours alcohol slightly. . . . . It appears very certain that power alcohol cannot be produced from the raw materials of the Empire or of this country to compete with petrol to-day, but with all associated problems solved, it should be capable of furnishing a liquid fuel at not too excessive a price in the event of petrol shortage and raised prices or petrol failure. If a biological process for the conversion of waste cellulosic material into a fermentable carbohydrate should become available shortly, as is by no means impossible, fermentation alcohol would still find it difficult to compete with petrol at present prices, considering the small margin for collection, transport, degradation into fermentable sugar, etc. . . . . Synthetic methyl alcohol on the other hand presents the possibility of almost immediate competition with petrol and the assurance of illimitable supplies of liquid fuel produced from coal in the event of a petrol failure. Conclusive demonstration that methyl alcohol is entirely satisfactory in the internal combustion engine has not been reported, and it does not necessarily follow that what applies to ethyl alcohol holds equally well in the case of the homologue methyl alcohol. . . . . Synthetic methyl alcohol, therefore, or liquid fuels produced in the future by simple catalytic gas reactions, may be regarded as more likely competitors and, in any case, strong antagonists both in respect of other synthetic fuels or fermentation alcohol in the event of serious diminution or failure of petrol supplies. The chemist will have a large part to play in the economics of the world's liquid fuel supply in the none too distant future, and he will draw upon immense coal resources for his basic raw material in any of the processes considered. Evidence is not wanting that a biological method for the saccharification of cellulose—so very abundant and reproducible every year—will not be long delayed in its appearance, but transport and other problems will be much more acute in vegetable alcohol production than in the case of a power spirit manufactured from coal as raw material."

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[1] U.S. Patent, 1,311,336; *I.S.J.*, 1920, 60.

BEET DESICCATION PREVIOUS TO EXTRACTION. *Charles C. Moore.* *Sugar Beet Journal, 1925, 8, No. 4, 26-27.*

Supplementary to his previous article,[1] the author remarks that on desiccating roots the reduction in tonnage, (a shrinkage of three tons of fresh beets to one ton of dried cossettes) makes a reduction in freight costs that is about equivalent to the cost of dehydration. He then quotes from an article by O. W. WILLCOX,[2] who has stated that "One way, and a fairly well known one, to stop respiration and sugar loss is to slice the beets and dry the slices at a low heat. This proposition is not a new one ; it has been put forward repeatedly both in this country and in Europe. It is known, beyond dispute, that sliced beets may readily be deprived of their moisture and that the dried slices can be stored indefinitely without material deterioration or loss of sugar content. It is further known that these dried slices can be put through the usual diffusion process with the advantage that a more concentrated diffusion juice can be obtained with resultant saving in cost of equipment, in fuel cost and in general operating expense. However, data are lacking on one point. When beets are dug, taken to a local evaporating station, washed, sliced, and dried, what are the sugar losses? . . . . Something more than $1·60 per ton." Lastly, the author comments: "It would be, of course, a commonsense procedure to store the dried cossettes instead of storing the crude sugar; and a central factory, located anywhere, could instal facilities for extracting the sugar from the dried cossettes. The outlay in machinery, under the present conditions, in a sugar factory, consists in having an equipment to handle a large tonnage in about 100 days operation. If the tonnage is reduced to one-third, and there are 365 days operation for the reduced tonnage, a simple computation shows the economy derived from dehydrating the cossettes as a previous step in the industry. If this procedure results in a saving in freight cost that offsets the cost of drying the cossettes, and, in addition, results in a saving of $1·60 per ton of fresh beets through preventing or avoiding the loss of sugar that occurs while the beets are piled and waiting to be ground, why is it not being done?"

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[1] *I.S.J.*, 1925, 391.

[2] *Facts about Sugar*, 1925, 20, No. 24, 568-569.

HYDROXYL-ION CONCENTRATION AND VOLUMETRIC ALKALINITY IN THE CLARIFICATION OF BEET JUICE.

A. H. W. Aken and P. J. H. van Ginneken. Tijdschrift, 1924, 89; through Vereins-Zeitschrift, 1925, 260-283.

Carbonatation in the beet sugar industry is now regarded from the point of view of the colloidal theory, always having in view the establishment of the conditions under which good filtering scums, easily washable to a low sucrose content, can be obtained Working according to the alkalinity as determined volumetrically leaves much to be desired, especially with juice from frozen or altered roots. Modern theory states that the formation of precipitates, the flocculation of colloidal substances, and the adsorption of colloids on crystals, that is phenomena occurring during the purification of juice, are all controlled by the electrical charge of the particles. Since this charge is very strongly dependent upon the hydrogen-ion and hydroxyl-ion concentration, it follows that ordinary titration cannot be used as a guide. By means of a modified form of hydrogen-electrode potentiometer, the hydroxyl-ion concentrations were determined for juices after first and second carbonatation, and for the carbonatated juice after sulphitation, comparison being made with an artificial juice consisting of a solution containing 12·5 per cent. of sucrose and 1 per cent. of potassium chloride to which lime was added. It was found that at the same volumetric alkalinity the hydroxyl-ion concentration of the ordinary limed beet juice was considerably lower than that of artificial juice (containing only lime). These comparisons of the alkalinity and hydroxyl-ion concentrations led to the conclusion that in the beet products examined strong, medium, and weak bases are present. At the termination of the first carbonatation, the hydroxyl-ion concentration is not very much lower than that of the limed artificial juice; after the second the difference is greater; and after sulphitation it is greater still. Hence, during these operations the strong bases (mainly lime) are progressively removed, so that when the juice enters the evaporators almost only the so-called "weak" bases remain.

BROM THYMOL BLUE IN PRACTICE [AS INDICATOR OF THE HYDROGEN-ION VALUE].

G. Fransen. Archief, 1925, 33, No. 45, 1230.

At the suggestion of the Experiment Station at Pasoeroean a test was made at the Soekodono factory towards the end of the last campaign in Java on the method of controlling liming in juice clarification by using colour indicators for showing the hydrogen-ion concentration, or *pH*. Use was made of a small quantity of brom thymol blue sent by the Station, and the reaction was so adjusted that this indicator gave a green colour, this being assumed to correspond with a *pH* of 7·0, that is, true neutrality. Comparison was made by the ordinary titration with N/32 alkali, in this case employing phenolphthalein, when it was found that juice limed to the above reaction showed a titratable acidity varying between 130 to 180 mgrms. of SO_2 per litre. Up to that time the juices worked at the factory named had usually a reaction corresponding to 70–90 mgrms. of SO_2 per litre towards phenolphthalein, this giving to brom thymol blue a blue colour, in this way showing the presence of an excess of OH-ions. It was observed that when liming to a green colour to brom thymol blue, that is, working more "on the acid side," a greater volume of clear juice could be drawn off, thus considerably relieving the overburdened muddy juice sulphitation and filtration stations. Determinations of the reducing sugars were made in the raw, the clear, and the thick juices, these tests demonstrating that the amount of "glucose" per cent. of the non-sugars remained constant throughout, thus removing any fear of the possibility of inversion having occurred while thus operating. No difficulty at all was experienced in the curing of the massecuite.

Official Figures for German Sugar Production for 1923-24. *Die deutsche Zuckerindustrie, 1925, 50, No. 38, 1265-1278.* Here are recorded in considerable detail the results of the 1923-24 campaign regarding production and taxation. Results are given here and there also for previous years, and the comparisons are striking.—Occurrence of Raffinose in Refined Sugars. *G. Schecker. Die deutsche Zuckerindustrie, 1925, 50, No. 43, 1413.* R. Mehrle had stated[1] that the white sugar from a refinery which does not desaccharify contained 0·15 per cent. of raffinose, and that the washed crystals from a first-product raw beet sugar having 0·024 per cent. of ash contained 0·27 per cent. of the trisaccharide. But the author denies the possibility of such results, stating that he has proved that the crystallizing of raffinose with sucrose is to be observed only in the purer massecuites of refineries which desaccharify.[2] Sources of error in the determination of raffinose are summarized, and it is shown that an error of at least 0·2 can easily arise.—Graphical Rectifying Column Calculations. *E. V. Murphee. Industrial and Engineering Chemistry, 1925, 17, No. 9, 960-964.* Graphical methods of making rectifying column calculations for binary mixtures in both plate and packed columns, based on material transfer equations, are outlined; and examples are given of their use.—Dust Explosions in Industrial Plants. *Hylton R. Brown. Ibid., 1925, 17, No. 9, 902-904.* Deals with the causes of dust explosions in plants producing dust, and suggests methods of reducing the risk. Where it is possible to reduce the formation of dust, or to eliminate sources of ignition entirely, an atmosphere of diminished oxygen content should be maintained.—Controlling the Density of Milk-of-Lime. *M. Beckman. Archief, 1925, 33, No. 39, 1006-1007.* A Vivien tube of certain dimensions (here stated), and marked 0, 10, 15, and 20, is used, the milk being added to the 10 mark, then hydrochloric acid of such concentration that, when it reaches the 15 mark, milk of 15° Be. is just neutralized, phenolphthalein being the indicator.—Carbon Monoxide in CO_2 Kiln Gases. *P. G. Galsbutski. Zapiski;* through *Centr. Zuckerind., 1925, 33, 1477.* Objections to its presence are: (1) increased consumption of fuel, and (2) prejudicial effect on the composition of the juices, a slimy scum being obtained in the presses. An average lime kiln gas contains 2 per cent., but, say only 1 per cent., this means half a ton more coal in a factory slicing 600 tons daily.—Judging the Value of Raw Beet Sugars in Holland for affining in the Refinery. *Anon. Die deutsche Zuckerindustrie, 1925, 50, No. 47, 1521.* For 15 years past Dutch beet raw manufacturers have taken part in a mutual system of comparison of the colour of their washed crystals during 10 weeks of the campaign, this having resulted in a considerable improvement in the actual colour of the crystal, the figure for last year, for example, being 0·3–0 4, as compared with 0·5 during 1918-19, and 0·8 during 1911-12, with the standard colour equal to 1·0.—Identification of "Norit" and other Wood Charcoals. *H. G. Tanner. Ind. and Eng. Chem., 1925, 17, No. 11, 1191-1193.* Microscopic and macroscopic tests made with charred woods of different trees lead this author to the conclusion that "Norit" decolorizing carbon is made from birch, probably *Betula occidentalis.* He believes that the process used is firstly the reduction of the wood sawdust in the presence of a limited quantity of air, followed by acid extraction, washing, and drying. A number of microphotographs illustrating the work carried out are presented. J. P. O.

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[1] *Die deutsche Zuckerindustrie,* 1925, 50, No. 40, 1325-1328.

[2] *Zeitsch. Verein. deut. Zuckerind.,* 74, No. 810.

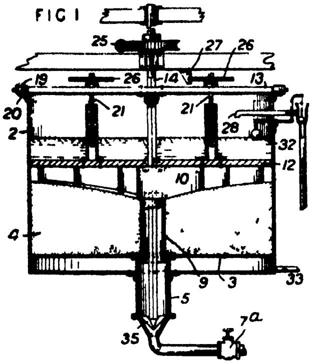
Review of Recent Patents.[1]

UNITED KINDGOM.

Filter (for Sand, etc.) with Means of removing the Fouled Filtering Surface.* *R. Haddan* (*Cycle Company*, of Broadmore, Colorado Springs, U.S.A). *241,453*. March 23rd, 1925

This apparatus for filtering muds and the like employs a combined percolative and settling action, the fouled strata of the bed being recovered by scraping as filtration proceeds. Sand, or other filtering material *4*, is supported on the perforated false bottom *3* of a tank *2*, to which the liquid is supplied by a pipe *28* under the control of a float *32*. A bar *12* carried by a shaft *14* driven by a worm *25* carries scrapers *10*, which conduct the fouled strata of the bed *4* to a well *9* extending through the bed. The bar *12* is progressively lowered by screws *21*, which are operated at each revolution of the shaft *14* by the engagement of a detent *27* with toothed wheels *26*. The well *9* is lowered simultaneously into a sump *5*, where the discharged matter is agitated by blades *35* to ensure a regular discharge through a cock *7a*. Filtered liquid is withdrawn through a pipe *33*, which may be connected to a suction pump, and the process may be expedited by decanting the liquid in the top of the tank *2*. The bar *12* is carried by a bar *13* extending across the tank and provided with rollers *19* running on a flange *20*. A plurality of scrapers *10* may be employed, or one spiral scraper may be attached directly to the shaft *14*

FIG 1



Automatic Feed Weighing Apparatus.* *B. Boulogne*, of Pasoerean, Java. *240,881*. October 6th, 1925; convention date, October 6th, 1924.

In an automatic weighing-apparatus, in which the material is weighed on a continuously moving carrier, the constantly oncoming material to be weighed is temporarily diverted from the weighing carrier while the load present on the carrier is being registered, said diverted material being added to the next charge, between which and the charge already weighed there exists a gap. A conveyor band operated by a motor is suspended from two weighbeams and the load thereon is counterbalanced by a pendulous resistant connected to a registering device Normally the material is fed from a conveyer down a shoot on to the band. When the band is fully charged, the material is temporarily diverted by a plate on to an auxiliary conveyor and the load is registered. The auxiliary conveyor travels at about half the pace of the main conveyor so that a gap is formed between each two charges. The cycle of operations is governed by a cam-disc which may be driven from the conveyor.

Discharging Device for Centrifugal Machine. *E. van der Molen*, of Groningen, Holland. *241,108*. April 14th, 1925

In a centrifugal machine, the drum has an open top and is provided with a knife attached to a sloping curved shoot. Both knife and shoot are carried by a slide on a bar supported by the fixed casing of the machine. A screw enables the knife to be brought into contact with the deposit on the drum and the speed of the machine causes the discharged material to pass up the shoot over the drum.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C 2 (price 1s each) Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*) with the permission of the Controller of H.M. Stationery Office, London Sometimes only the drawing or drawings are so reproduced *United States*: Commissioner of Patents, Washington. D C (price 10 cents each. *France*: L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany*: Patentamt, Berlin, Germany.

FILTER-PRESSES OF THE KROOG TYPE.* *George Fletcher & Co., Ltd.* (*F. A. Everaarts*, of Semerang, Java). *241,054.* December 29th, 1924.

Relates to filter-presses of the Kroog type particularly for dealing with sugar solutions. Two channels formed by holes in lugs *a*, *b* on the filter plates and alternate cavity frames are used for (1) supplying dirty liquor through the lower channel until the frames are partially filled with cake; (2) passing wash-water, also through the lower channel, to the cakes to remove the residual liquor and reduce the percentage of sugar; (3) passing air through the upper channel to remove the remaining wash-water through the outlet end of the lower channel, and to dry the cakes; and (4) passing steam for further drying if necessary. The filtering and washing is carried out under constant pressure to avoid dislodging the cakes from the filter-cloths. The lower channel in the lugs *a* is connected at one end to the valve-controlled supply pipes *d*, *e* for dirty liquor and wash-water, and to the pressure pipes *s*, *v*, and at the other end to a valve-controlled outlet *g* for the residual wash-water. An ejector is connected to the outlet *g*. The upper channel in the lugs *b* is connected to a steam-supply pipe having a by-pass and to air inlets *k*, *l*. The filter sections are provided with drain-cocks *n* for the filtered liquor, and with small drain-cocks *w* for the wash-water.

FIG.3.

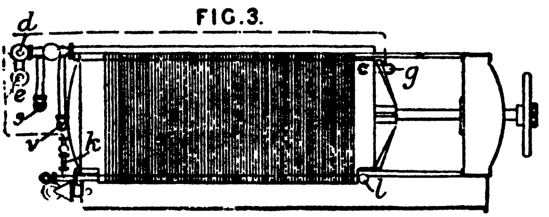
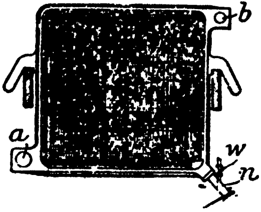


FIG.4.



REVIVIFICATION OF ABSORBENT CARBONS.* *A. Backhaus*, of Rognel Heights, Baltimore, U.S.A. (*A*) *240,126.* June 4th, 1925; convention date, September 17th, 1924. (*B*) *240,127.* June 4th, 1925; convention date, September 17th, 1924.

(*A*) Absorbent material, particularly activated charcoal, which has been used in the purification of fermentation carbon dioxide, is revivified by passing steam through a bed of the material and drying the bed by means of a hot gas, e.g., air, nitrogen or carbon dioxide at a temperature of 60-150° C. Removal of absorbed impurities during the first part of the operation is hastened by circulating steam through pipes in contact with the material, which is finally cooled by circulating cold water through the pipes. (*B*) An apparatus for revivifying absorbent materials, e.g., activated charcoal used for carrying out the process claimed in Specification 240,126 (above), in their place of use, comprises a container divided into two chambers, an upper and a lower one, by a perforated plate, and a plate carrying U-shaped pipes. The lower chamber is subdivided by a partition and provided with inlet or outlet pipes for admitting a heating or cooling medium, e.g., steam or water, to the pipes mentioned. The absorbent material is supported on the plate and surrounds the pipes, the pipes being centred in the perforations in the plate. A collar or bonnet with notches surrounds each pipe and covers the perforation through which it passes, thus permitting the free passage of gas between the two chambers and preventing the absorbent material from packing around the perforations in the plate Absorbent material may be placed inside the pipes, the heating or cooling medium being circulated around them, or a water-jacket may be used, instead of the pipes, for heating and cooling the absorbent material.

CONFECTIONERY. (*A*) *F. G. Fryer and M. Cohen,* of New Earswick, Yorkshire. *235,957.* March 26th, 1924. (*B*) *A. Johnson,* of Metropole Hall, Hull. *237,340.* April 23rd, 1924. (*C*) *F. G. Fryer,* of St. Peters Grove, York. *237,645.* April 28th, 1924. (*D*) *H. Wheatley and T. Armstrong,* of Rathgar, Dublin. *238,348.* July 11th, 1924. (*E*) *O. Thürmann,* of Berlin. *238,488.* April 8th, 1925. (*F*) *Bühlei Geb.,* Uzwil, Switzerland. *238,880.* August, 17th, 1925; convention date, August 22nd, 1924. (*G*) *Petzholdt Maschinen-fabrik,* of Freital, near Dresden, Germany. *241,884.* October 8th, 1925 ; convention date, October 22nd, 1924.

(*A*) In the manufacture of chocolates, more particularly chocolate-coated goods, the chocolates are polished when cool and set by brushes or other means, which work in intersecting directions. (*B*) An appliance for making and decorating confections comprises a small rigid or non-rigid jacketted container having one or more nozzles or piping members. (*C*) In reducing or refining apparatus for chocolate, cocoa, etc., of the kind comprising relatively rotatable metal grinding discs yieldingly pressed together, each disc is provided with concentric ring-formed dividing walls or rings approximating to circles having a wavy or zig-zag form. Some or all of the spaces may be provided with annular rows of reducing pockets or may consist of ring-formed pockets. (*D*) This specification relates to cutters of machines for moulding caramels and the like. (*E*) In a mill for grinding cocoa, chocolate, and the like and of the kind comprising a central rough grinding device with a vertical spindle and with ball-and-ring grinding devices for fine grinding concentrically arranged about the spindle, some or all of the runner parts of the grinding devices are driven from the central vertical spindle without the grinding pressure of any of the runner parts against the fixed lower grinding surfaces being affected by any other runner part. (*F*) Chocolate is prepared in a single machine through which a stream of hot fresh air is continuously passed, the machine comprising an enclosed rolling mill, in which the rolling, stoving, and conching are effected, having a trough for mixing and kneading the material. (*G*) In apparatus for finely disintegrating and rubbing down preliminary disintegrated cocoa beans, cocoa, chocolate, and the like, the particles of material are brought into a rapidly revolving motion against the action of retarding means, such as retaining and rubbing surfaces embracing or surrounding them, and is driven along the surfaces.

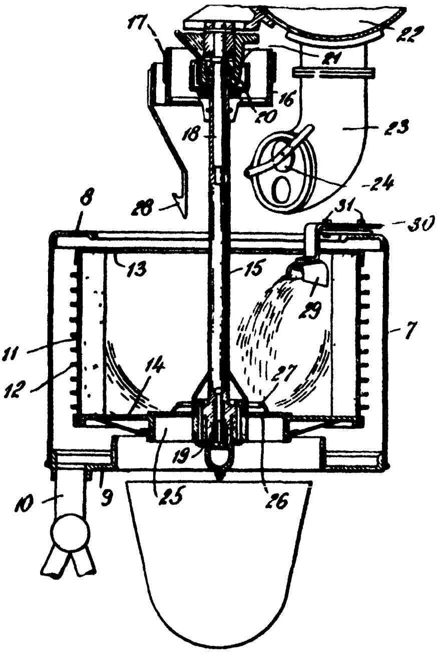
PROCESS OF YEAST PRODUCTION FROM CANE OR BEET MOLASSES, USING NUTRIENTS. *International Yeast Co.,* of London (Assignees of *R. L Corby* and *W. H. F. Bührig*). *238,554* August 13th, 1925. In making yeast in a yeast-nutrient solution, preferably of the sugar salt type, by aeration and regulated additions of the nutrients at one or more stages of the process, a portion only of the yeast-containing liquid produced at any given stage is withdrawn, the residue being diluted and the process continued. For the nutrient solution, cane or beet molasses or a mixture thereof may be clarified, for example, by heating with ordinary superphosphate of lime with or without the addition of a small amount of ammonia or a compound thereof, the resulting mixture being filtered. At one or more intermediate stages in the process the additions of nutrient may be reduced or stopped entirely and the degree of aeration may also be lowered. At the beginning of the process or of a stage thereof, the temperature of the solution may be higher than that normally employed, for example, about 33°C., and during the first few hours the temperature is allowed to fall gradually to the normal or 30°C. The starting condition may be obtained by suspending seed yeast in a non-toxic acqueous liquid or a dilute nutrient solution, and the seed yeast for this purpose may be obtained by the use of a portion of the yeast-containing liquid withdrawn at a previous stage.—CENTRIFUGAL MACHINES. *Laughlan Corporation Filter* (Assignees of *W. C. Laughlan,* of Catesby, Cal., U.S.A.). *235,916.* June 22nd, 1925 ; convention date, June 21st, 1924. Solids are separated from liquids in a density separator, and the liquids are then passed through a strainer while the solids are removed by a rotary guide in the direction contrary to the action of the centrifugal forces.

Patents.

UNITED STATES.

CENTRIFUGAL, HAVING DEFLECTOR TO PREVENT CREEPING. *Alfred Hoffbauer* (Assignor to *The American Sugar Refining Co.*, of New York, U.S.A.). *1,545,832.* July 14th, 1925.

The invention involves the arrangement of a deflector in adjustable relation to the upper edge of the revolving basket, with an edge so disposed as to intercept any sugar tending to rise above a given level and shaped to direct this sugar inwardly and downwardly towards the centre of the basket. Referring to the drawing, *7* indicates the casing of the centrifugal separator. The top of the casing is partially closed by an annulus *8* forming a shelf extending inwardly from the cylindrical wall *7* a short distance. Bottom of the casing is partially closed by an annulus *9* in which is an outlet *10* for the syrup. The outlet *10* of the conduit leading therefrom may be provided with a syrup separator (as is indicated diagrammatically in Fig. 1) which permits of segregating two or more different grades or qualities of syrup. Within the casing is the rotary basket consisting of a cylindrical screen *11* sustained by rings *12*. At the top of the basket is a flange *13* extending inwardly from the cylindrical wall a short distance. The bottom *14* of the basket is secured to a hollow shaft *15* extending upwardly a substantial distance above the basket and carrying a pulley *16* on which a belt *17* runs to transmit rotary motion at high speed to the basket. The basket is mounted upon a shaft *18* extending through the hollow shaft *15* and having a bearing *19* at its lower end upon which the weight of the basket and the parts rotating therewith is received. Secured to the shaft *18* near its upper end is a spherical member *20* which is received in a bearing *21* suspended in any suitable manner from the overlying structure. The sugar mass is admitted to the basket from a suitable receptacle *22* through a discharge outlet *23* provided with a closure *24*. In the bottom of the basket is an annular opening *25* through which the sugar passes out of the basket. This opening is adapted to be closed by a cover *26* consisting of an annular plate adapted to rest upon the upper surface of the bottom plate *14* of the basket. On this cover *26* is an annular flange *27*. Above the basket is a hook *28* extending downwardly from the supporting structure, the arrangement being such that the cover *26* may be lifted from its closed position upwardly out of the basket and suspended from the hook *28* by engaging the flange *27* over the hook. The usual plough or scraper, supported for vertical movement within the basket in close relation with the walls thereof, may be provided to remove the caked sugar at the conclusion of the separation, which plough is particularly to be distinguished from the present invention since its function is entirely distinct. It is movable for the purpose of scraping the walls of the basket, and is only used at the conclusion of the separation; whereas the deflector here claimed remains stationary in adjusted position and deflects the sugar tending to climb over the edge of the basket during the separating operation. This deflector *29* is supported on a bar which is in turn secured, by bolts *31*, for example, to the annulus *8*. It consists of two

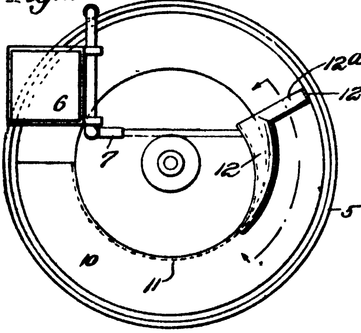


blades spaced apart and connected by a web, and is shaped to direct the sugar inwardly and downwardly. It is provided with an edge which is adjusted in spaced relation with the wall of the basket slightly below the flange thereon. As the basket rotates, the sugar is forced against the screen, and any surplus tends to climb over the upper edge of the basket. This surplus is promptly caught by the deflector and returned to the basket. Introduction of the deflector in a centrifugal separator ensures a material saving for the reason that all of the sugar which is delivered to the basket is retained therein. The separation efficiency of the centrifugal is increased and the escape of crystallized sugar in the syrup is avoided.

CENTRIFUGALS HAVING SPRAY SHIELD. *Eugene Roberts* (Assignor to the *Western States Machine Company*, of Salt Lake City, Utah, U.S.A.). *1,550,095*. August 18th, 1925.

During the washing operation when the machine is revolving at high speed, it produces very strong air currents with the result that a cloud of spray is carried up out of the basket. The present invention overcomes this by providing a curved shield to divert the cloud of spray into the space between the basket and its surrounding curb as the spray issues from the inside of the basket rim. The centrifugal machine may be of any usual type and as shown comprises the perforated basket *2*, suspended from the rotary spindle *1*, and having an inwardly turned rim or top ring *3* which serves to prevent the overflow of the solid matter at the top of the basket as it builds in from the peripheral wall, the liquid passing through the peripheral wall itself under centrifugal action. The surrounding curb or casing *4*, is of usual construction and is surmounted by the usual top ring *5*, having an inwardly projecting ledge 5^{a}. On the curb is mounted any preferred form of sprayer mechanism *6*, which in this case has an oscillating nozzle *7*, arranged to direct a column of fine spray across the basket against the wall of sugar on the opposite side of the centre. The form of spray shield illustrated in the drawings comprises a curved shield of arcuate form *10*, extending substantially half way around the basket and having a depending flange *11* at its inner edge located approximately in line with the inside edge of the basket rim except that at its intake or deflecting end the portion 11^{a} is carried inward a substantial distance inside the line of the basket rim. At the intake end of the spray shield, a trough-like member *12* is provided, the trough being inverted so that its open side is downward astride of the inside edge of the basket rim. The trough preferably is trumpet form, that is, converging in the direction of rotation of the basket. At its receiving end it extends transversely across the arcuate plate *10* approximately radially of the basket so as to form a sort of inverted scoop with a curved wall arranged to deflect the air currents and the cloud of spray downward over the outside of the basket rim into the

Fig. 1.



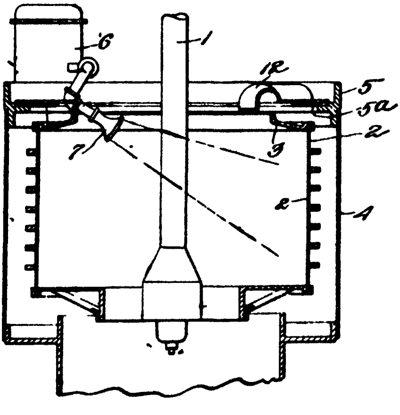


Fig. 2

space between the rotating basket and its surrounding curb. The outer end of the transverse portion *12ª* of the trough or deflector is closed by means of the peripheral wall at *12ᵇ*. With this arrangement the wet, sticky spray, instead of spraying over the operator and everything else near the machine, is diverted to the inside of the curb and outside of the basket thereby entirely eliminating what has heretofore been a great nuisance in the operation of the machine and conserving the syrup content that is wasted by thus escaping from the basket, since such content is now collected in the bottom of the curb.

Device for Washing Sugar in Centrifugal Machines. *Eugene Roberts* (assignor to *The Western States Machine Co.*, of Salt Lake City, U.S.A.). *1,550,094.* August 18th, 1925.

This invention relates to apparatus for washing sugar or other material in a centrifugal basket after the juice or syrup has been centrifugally extracted, and is in the nature of an improvement upon the washing apparatus shown in the Roberts and Gibson U.S Patent 1,224,095, of 1917. It is intended to simplify the construction of the apparatus, improve its operation, and obtain more precise or exact determination of the period of the washing or spraying operation. In general it comprises a constantly rotating shaft combined with an intermittently connected timing shaft and automatically controlled timing mechanism with suitably combined valve-closing and nozzle-actuating connexions by which the duration of the period of washing is exactly controlled in accordance with the predetermined setting of a regulator. Another feature comprises the combination of automatic timing mechanism and nozzle-actuating and valve-closing devices with a regulator operatively associated with a regulating dial member or index by which the exact setting can be readily determined appropriate to various grades of sugar to be treated. Claim reads as follows:—In a machine for washing sugar, the combination of a continuously rotating driving member, an actuating shaft, means for forming a disconnectible driving connexion between said driving member and said shaft, a cut-off valve, valve closing mechanism, a movable carriage operatively connected with said valve closing mechanism to prevent it from normal action, a timing member mounted on said carriage and having disconnectible driving connexion with said actuating shaft, said carriage acting simultaneously to establish operative connexion between said driving member and said timing member with said shaft, and to cause their simultaneous release from driving connexion therewith, substantially as described.

Production of Active (Decolorizing) Carbon. (*A*) *E. Hene.* *1,547,037* July 21st, 1925. (*B*) *Metallbank u. Metallurgische Ges. A.-G.*, of Frankfort-on-Main, Germany. *238,889.* August 20th, 1924; convention date, August 20th, 1924.

(*A*) Porous coal is heated with a sulphur compound of an alkali metal which is reducible on heating with carbonaceous material to the sulphide, the temperature of heating being at least 600°C., after which the soluble salts are leached out. (*B*) Active carbon of high mechanical resistance is obtained by carbonizing pieces of hard wood or shells such as coco-nut shells or walnut shells after impregnation with zinc chloride.

GERMANY.

Adhesive Preparation from Beet Slices. *A. Volpino.* *402,625.* April 16th, 1921; convention date, April 17th, 1920. According to this Specification, the exhausted beet slices are heated with 0·3 to 0·8 per cent. of sulphuric, hydrochloric or sulphurous acid for one to three hours at 100 to 110° C. under pressure. After centrifuging, the clear liquor is neutralized with calcium carbonate or sodium bicarbonate, any calcium sulphate that precipitates is removed, and the filtrate is evaporated. Neutralization is unnecessary if sulphurous acid is used.—Decolorizing (Active) Carbon, its Production, Application, and Revivification. *E. Berl.* *411,953.* March 17th, 1923. In order to prevent spontaneous ignition, and the oxidation of adsorbed substances by condensed oxygen, the carbon is impregnated with very small quantities of tin compounds, glycerol, sugar, mannitol or other polyhydric alcohols.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending December 31st.		Twelve Months ending December 31st.	
Unrefined Sugars.	1924. Tons.	1925. Tons.	1924. Tons.	1925. Tons.
Poland	25,452	1,772	62,505	11,133
Germany	1,879	....	3,899	1,962
Netherlands	....	....	....	....
France	....	....	....	....
Czecho-Slovakia	885	....	23,883	1,030
Java	36	....	86,443	27,032
Philippine Islands	....	....	....	....
Cuba	....	63,717	456,163	723,136
Dutch Guiana	....	....	...	....
Hayti and San Domingo	....	....	106,730	135,521
Mexico	....	....	....	....
Peru	5,224	13,307	89,152	78,220
Brazil	295	....	22,622	6,632
Mauritius	10,062	47,790	124,000	83,421
British India	...	....	....	....
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	2,948	6,598	55,128	129,076
Other Countries	11,387	30,205	128,961	154,206
Total Raw Sugars	**58,169**	**163,389**	**1,159,486**	**1,351,369**
Refined Sugars.				
Poland	11,620	2,307	28,204	16,776
Germany	5,327	658	32,794	8,058
Netherlands	24,844	34,152	169,405	238,637
Belgium	8,860	1,211	48,445	15,947
France	....	....		....
Czecho-Slovakia	41,449	31,195	219,481	194,476
Java	....	....	....	....
United States of America	78	9,797	60.943	178,274
Canada	....	4,896	25,064	107,643
Other Countries	167	5,186	10,917	10,141
Total Refined Sugars	**92,345**	**89,401**	**595,254**	**769,952**
Molasses	12,516	23,764	170,291	215,399
Total Imports	**163,030**	**276,554**	**1,925,031**	**2,336,720**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	Tons.	Tons.
Denmark	....	117	5,778	1,019
Netherlands	15	52	670	313
Irish Free State	3,720	4,555	50,423	55,329
Channel Islands	100	62	1,098	900
Canada	....	....	....	.. .
Other Countries	1,337	326	14,399	8,319
	5,172	5,112	72,367	65,879
Foreign & Colonial Sugars.				
Refined and Candy	134	163	5,670	2,165
Unrefined	97	53	11,199	740
Various Mixed in Bond	....	....	....	....
Molasses	64	56	2,839	490
Total Exports	**5,467**	**5,384**	**92,075**	**69,274**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925. Tons.		1924. Tons.
Total Receipts, January 1st to December 30th	3,356,241	..	3,015,633
Deliveries " "	3,347,585	..	3,016,427
Meltings by Refiners " "	3,304,380	..	3,003,110
Exports of Refined " "	270,000	..	178,000
Importers' Stocks, December 30th	8,656	..	—
Total Stocks, December 30th	60,668	..	15,956
	1924.		1923.
Total Consumption for twelve months	4,854,479	..	4,780,684

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1924-25 SEASON.

(Tons of 2,240 lbs.)	Tons.
Exports	4,650,474
Stocks	292,119
	4,942,593
Local Consumption	135,000
Receipts at Ports to November 30th, 1925	5,077,593

Havana, November 30th, 1925. J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWELVE MONTHS ENDING DECEMBER 31ST, 1923, 1924, AND 1925.

IMPORTS.	1923. Tons.	1924. Tons.	1925. Tons.
Refined	386,050	595,254	769,952
Raw	1,167,903	1,159,486	1,351,369
Molasses	133,666	170,291	215,399
	1,687,619	1,925,031	2,336,720

EXPORTS (Foreign).	1923. Tons.	1924. Tons.	1925. Tons.
Refined	15,268	5,670	2,165
Raw	25,413	11,199	740
Molasses	3,078	2,839	490
	43,759	19,708	3,395

HOME CONSUMPTION.

	1923. Tons.	1924. Tons.	1925 Tons.
Refined	378,115	566,838	674,118
Refined (in Bond) in the United Kingdom	940,057	868,401	876,950
Raw	152,041	127,899	111,914
Total of Sugar	1,470,213	1,563,138	1,662,982
Molasses	10,082	7,136	7,555
Molasses, manufactured (in Bond) in United Kingdom	55,409	60,793	59,453
	1,535,704	1,631,067	1,729,990

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT DECEMBER 31ST, 1925.

	1922 Tons	1923. Tons.	1924 Tons
Refined in Bond	41,150	22,650	57,350
Foreign Refined	27,550	40,400	121,950
" Unrefined	88,700	92,850	236,300
	157,400	155,900	415,600

United Kingdom Monthly Sugar Report.

Our last report was dated the 10th December, 1925.

The market has been fairly steady throughout the period under review and to-day there is no appreciable change in prices from a month ago.

The London Terminal Market has not been so active as during the past two months and the daily registrations have not been in such large volume. This is probably accounted for by the Christmas and New Year holidays which have intervened. Outside speculators are still clinging to their bull position; as each month's delivery comes round they transfer forward. Over 50,000 tons were tendered in December, but this did not cause unnecessary liquidation, as the sugar was all taken up against forward sales of paper. December was finally liquidated at 14s., having fluctuated from 13s. 6d. to 14s. 3d. A fair business was done in January at 13s. 9d. to 14s. March was traded in from 14s. 3d. to 14s. to 14s. 9¾d. to 14s. 1½d., May from 14s. 6d. to 15s. to 14s. 6d. to 14s. 7½d., and August from 14s. 10½d. to 15s. 6d. to 15s. 3d. Dealings were started in the New Year in new crop delivery, and December was sold at 15s. 9d. to 15s. 3¾d. The latest prices are: January, 13s. 10½d.; March, 14s. 1½d.; May, 14s. 6¾d.; August, 15s. 1½d.; December, 15s. 3¾d.

Trading in actual sugar has been on the quiet side presumably owing to the intervention of the holidays. Ready Granulated has been scarce owing to the navigation on the Elbe being closed and up to date it has not officially been opened, although good quantities have been arriving at Hamburg. Various Czecho marks sold from 14s. 9d. down to 14s. 1½d. to 14s. 3d. There is still little demand for forward, as the premiums are considered too high. American Granulated is not offering at competitive prices. There has been a good demand from India for White Javas and there are buyers of January/March shipment at 16s. 3d. c.i.f India. India has also made purchases of Hungarian Crystals at 15s. 6d. c.i.f. India, which is an extraordinarily good price against European values. Spot sugars in London have been plentiful owing to tenders. Dutch, Czecho and American Granulated sold up to 27s. 6d. duty paid, but the latest price is 27s. 3d. A small quantity of Javas and Mauritius have been sold at prices ranging from 24s. 9d. to 26s. 6d., according to quality.

The home-grown factories marketed good quantities of their sugar from 27s 9d. to 27s. 3d. to 27s. 9d. duty paid, subject to the usual rebates.

The British refiners have done a fair business and reduced their prices by 6d. per cwt. on December 10th. At the beginning of this year—on the increased demand from the trade—they advanced their prices 3d. per cwt. for Granulated on January 4th. Their latest prices are: No. 1 Cubes 31s. 9d., London Granulated 28s. 7½d., duty paid.

Only a small business has been done in raws to the British refiners. Cuban 96 per cent. fluctuated from 10s. 9d. to 11s. 6d. to 11s. 3d. c.i.f., whilst Perus sold from 10s. 9d. to 11s. c.i.f. and some Surinams at 11s. c.i.f.

In New York a good business has been done in raws and the price advanced from 2 5/16 to 2½ cents, but the value to-day is 2⅜ cents. The Futures Market has fluctuated in sympathy.

The stocks of old sugar at the ports in Cuba were reduced to 47,000 tons at the end of the year. The total stock to-day is 132,000 tons against 42,000 last year, and there are 120 Centrals working against 112 last year. HIMELY has issued an estimate for the forthcoming crop of 5,292,714 tons.

F. O. LICHT has reduced his estimate for Germany by 50,000 tons, making a total estimate for Europe of 7,482,000 tons against 7,077,791 tons last year, and without Russia 6,482,000 tons against 6,619,000 tons last year.

21, Mincing Lane,
London, E.C. 3.
January 11th, 1926.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE
INTERNATIONAL
SUGAR JOURNAL.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 326. FEBRUARY, 1926. Vol. XXVIII.

Notes and Comments.

Research in Sugar Beet Cultivation in England.

In the course of preparing a series of agricultural research monographs that would explain the bearing of research upon practical agriculture in this country, the Ministry of Agriculture (through the Agricultural Economics Research Institute of Oxford) has thought wisely to include one dealing with the problem of sugar beet cultivation in this country as deduced from the returns of certain farms in 1924. Elsewhere in this issue we give the broad results to be gleaned from a perusal of the monograph in question. At this early stage in the history of our new branch of agriculture the returns are necessarily inconclusive in character, but they serve the useful purpose, all the same, of providing a basis for constructive criticism and concrete suggestion, which cannot fail to be of value to the industry throughout the country.

It is clear that the ultimate success of the beet sugar industry in this country rests in no small a degree on the extent to which the farmer solves the new problems with which he is faced in the economic production and harvesting of this crop. The factory can improve its technique, but it cannot excel in economic output if the suppliers of the raw material fall below a certain standard in respect to quality, quantity and regularity of delivery. The labour problem is of course a serious one, seeing that it accounts for over 53 per cent. of the cost of production by the farmer, and it is pointed out that when the farmer most needs extra local labour for his harvesting he is liable to find the factory simultaneously competing for extra hands drawn from like local sources. Anything that would de-synchronize the work of the harvest and the factory might go some way to easing the labour problem. It is therefore of much interest to examine the possibility of drying the raw material on harvesting it and working it up at leisure into sugar during the rest of the year, or at least during a part of it after the termination of the "campaign" proper. This possibility of drying beetroots in an economical way without damage to their sugar contents has of course long been one of the unsolved problems of the beet sugar industry on the Continent,[1] and has been faced by its most able technologists. Whether the de Vecchis process, the patent rights for which in this country have been acquired by Sir Charles Cottier and transferred to the Government,[2] is really practicable and economical remains to be proved. It is a matter depending upon several factors, mainly on the cost of the necessary desiccation, an important item (though considerable improvements have been made during recent years in this branch of technology); also on the application of the heat in such a manner as to avoid sugar decomposition and other undesirable changes; and, further, on the mode of clarifying the juice which may be extracted from the dried slices in a much more concentrated condition than is ordinarily the case. It is therefore all to the good that the de Vecchis process is to be tried on the large scale at one of our new factories, though it is hoped that other efforts may likewise be made to attain the same end. Any economical procedure that tends to lengthen the period of manufacturing the sugar while inflicting no loss on the supply of raw material must improve the outlook, in that it would stabilize the incidence of labour.

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[1] See page 109. [2] See page 110.

Will a Ten-Year Subsidy suffice?

But when everything has been said for economical working and its application in the industry, the problem will arise at the end of 1933 as to whether the industry can pay its way without any subsidy at all. The authors of the monograph express no opinion on this score, but content themselves with remarking that "if a drop of 20s. a ton in the price of the roots is indicated when the subsidy ceases, the farmer will then have to rely for his profit on the indirect advantages the crop secures him, viz., the residual value of manures, cultivations, and the by-products of the crop." Whether he will be sufficiently content with these to continue supplying his quota to the local beet factory is a point on which opinions must differ; but it may be observed that the Government, having decided it is good for the consumer in this country that a home supply of such a necessity as sugar shall be extant, will in honour be bound to see that the industry does not languish because the principal cost, that of labour, is higher with us than with other sources of that commodity. The problem does not begin and end with the task of getting a cheap indigenous sugar supply. It rests also in the fact that such a supply, even if it has to be fiscally aided *sine die*, is some guarantee that our consumers will not be held to ransom for their sugar by foreign sources dictating the price they shall pay. The situation in the rubber industry where America, the consumer of 75 per cent. of the world's supply, has *nolens volens* to pay what she considers an excessive price for her needs in rubber because she has in the past refrained from taking steps to broaden the sources of her supplies, is only one concrete illustration amongst several that could be instanced as showing the undesirability of leaving foreign sources to cater for our necessities just because they are, under the stress of competition, comparatively cheaper. Remove the competition and then up goes the price.

For these broad reasons, then, it seems a fair assumption that while the sugar industry in this country must be stimulated to attain in the coming years a high degree of efficiency, it must not be saddled with the consequences of any standard of labour costs that is higher than those that rule in competitive quarters. If this country desires a high standard it must pay something for it, and it is worth paying something to have at our doors a substantial source of our requirements in sugar; so we have little doubt that when the ten-year period of subsidy expires, it will be renewed to some extent if really necessary. But by that time our new industry will have to justify itself up to a certain point, and if it can then hold its own unaided by any monetary grants, so much the better.

Notes and Comments.

Spontaneous Cane Seedlings.

At intervals reports are received of the sudden appearance of cane seedlings in or near to cane fields, usually in years of favourable conditions as to moisture. It is probable that these occasional appearances are not at all new, but have occurred at intervals ever since the cane has been cultivated; the crops of cane seedlings are, at first, very like a delicate grass and would, in all careful cultivation be immediately cleared away, that is before their distinctive character could be developed. A useful summary of such cases which have been recorded is given in DEERR's book, "Cane Sugar," and this is not likely to be substantially added to; we merely advert to the subject because of a letter recently received from a planter in Ceylon[1] in which he gives an interesting detail of the surroundings of the fields in a country where sugar cane is not a staple of any great importance, and which applies to various savage countries the world over. He states that the cane starts arrowing in the middle of August and is in full flowering in the following month: this is a period when the rains are in full swing and plenty of moisture is available for the germination and early growth of the somewhat delicate seedlings. For two years in succession, upon clearing the jungle adjoining cane fields, he was surprised to meet with seedling canes of quite respectable size, these being presumably sheltered by the thick vegetation. The canes grown were of Mauritius origin, many of which flowered profusely.

The appearance of new varities of cane in well-established cane tracts is usually put down to mutation by bud variation; and this is without doubt the usual method of their origin nowadays in such tracts. Any observant worker is accustomed to the appearance of such new varieties, although it must be confessed that they generally draw attention by some change in colour of stem or leaves, and more rarely by a complete change in habit. The observation is of special interest as bearing upon the extraordinary number of entirely new forms which have been found in the wild parts of New Guinea. Here no intelligent cultivation would be expected, and the sporadic groups of cane plants grown would be raised with jungle all around them; and thus full scope would be given in the favourable climatic conditions for the protection of the young seedlings, and their development until noticeable by the greater vigour inherent in most seedling canes, especially as the result of natural hybridization. Such new canes would of course stand a chance of being tried when seen by those cutting the jungly canes for chewing. Thus far it appears that only small portions of the British zone in New Guinea have been explored for new varieties; but now that part of the former German zone has come under Australian rule, it is expected that yet more startling results may be obtained when the country is sufficiently pacified for detailed exploration. The great diversity of the old-time canes cultivated has always been difficult to understand merely on the basis of mutation; and the origin of many good kinds in Oceania makes it highly probable that by a simple system of barter the new kinds thus evolved as natural seedlings have been the main source of the grand old canes of the pre-crossing days.

Australian Sugar Production during 1924.

According to a report of the Director of Sugar Experiment Stations in Queensland, the production of sugar in that state during the 1924 season amounted to 409,136 tons, the largest yield since 1917. Following on the severe drought experienced during 1923 the climatic conditions were most favourable in almost all districts, and a record crop of cane was produced, amounting to 3,171,341 tons of cane. The total area planted with cane has materially increased during recent years; in 1920 it was 162,619 acres, while in 1924 it had been extended to 253,519 acres, or an average to each planter of 36 acres. Out of this total of 253,519 acres under cane, 167,649 acres were crushed; the yield of cane per acre was 18·92 tons and the yield of sugar 2·44 tons per acre; but the tonnage of cane taken to make 1 ton of sugar was not so good as in the two previous years, due to the heavier rainfall, being 7·75, against 7·53 in 1922 and 7·60 in 1923. The number of mills operating in 1924 was 37 and of refineries 2, employing in all 6000 hands. The production of sugar in New South Wales in the same season was 16,829 tons and in Victoria, from beet, 3500 tons. The consumption of raw sugar per head is given as 138 lbs., which on a basis of a population for Australia of six millions would equal 369,000 tons.

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[1] Mr. A. W. WINTER, of Baddegama.

Prospects for the 1925 season are still better, according to the same authority. If the estimates of the various sugar mills are realized for that year, then Queensland will have produced some 3,753,000 tons of cane, which will be a record crop and should yield about 484,000 tons of raw sugar. New South Wales is expected to produce 32,000 tons of sugar and Victoria 3017 tons of beet sugar, making Australia's total output about 519,000 tons. This immense yield is the result of favourable seasons and the much larger acreage put under cane—some 90,000 acres more than in 1920, while the number of planters has jumped up from 4000 to 6000 in the same period. In order that all the cane can be crushed, many of the northern mills are being obliged to continue operations well into 1926, but everything depends on the weather remaining favourable, if they are to complete their task and leave no cane uncrushed.

The Disposal of the Australian Crop.

Mr. Easterby refers in this annual report to the hope expressed a year previously that the sugar industry would receive a continuance of the embargo placed on the importation of sugar grown abroad and the fixation of a fair price that would enable the industry to progress. Fortunately for the Australian sugar industry, these conditions have been accorded and it has been given a three years' breathing space, inasmuch as the period of the embargo on imported sugar has been extended to August, 1928. This concession was given by the Federal Government under certain conditions as to prices and concessions to manufacturers. These postulate that the price which will be received by the grower and the amount which will be paid by the consumer will be equivalent to that which would exist if the world's parity for sugar were reasonably stable and a tariff is imposed sufficient for the proper protection of the industry. The Government is of the opinion that under Australian conditions of production there is no possibility of the retail price for small parcels of the best refined sugar being less than 4½d. per lb., a price which is deemed to represent an advance on 1914 prices approximately equivalent to the increases in all other food products.

There remains, however, the problem of disposing of the surplus for export, which in the present season is expected to amount to fully 200,000 tons; this has given rise to some anxiety which has not been allayed by the shipping troubles extant during a large part of 1925, which have delayed deliveries of sugar and hampered the work of its speedy disposal. The handling of the raw sugar is controlled by a Sugar Board appointed by the Queensland Government. In the proclamation acquiring the sugar it was provided, we learn,[1] that 60 per cent. of the crop was deemed to be required for Australian consumption and 40 per cent.

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[1] *Australian Sugar Journal.*

for export. The prices to be paid were £26 and £9 10s. per ton respectively, or an average of £19 8s. This was a tentative basis only, and provision was made for an adjustment after the season had terminated, and the actual percentages were ascertainable. It was also provided that should the export sugar realize sufficiently (i.e., more than £9 10s. f.o.b.) to permit of a further payment in respect thereof, such would be made to the producers.

The Imperial College of Tropical Agriculture.

On December 9th last a paper on the Imperial College of Tropical Agriculture at Trinidad by Dr. H. Martin Leake (Director of the College) was read at a meeting of the Royal Society of Arts, at which the chair was taken by the Under-Secretary of State for the Colonies, the Hon. W. Ormsby-Gore, M.P. This paper, while of considerable merit, was of too general a character to warrant summarizing for our readers, being largely taken up with the broad problems of educating adequately the "overseers" of tropical agriculture generally; but in the discussion that followed, the remarks of a number of qualified speakers contained a good deal that was of interest to our view-point, and we extract from the *Journal of the Royal Society of Arts* the following excerpts.

The Chairman said that the paper revealed the Director of the College as a man of singularly wide outlook on the relation of the problems which he had to face day by day to the needs of the Empire and of the world. The College was singularly fortunate in having a man of Dr. Martin Leake's personality as its Director, not only on account of his enthusiasm for the technical work, but also because he combined with that the qualities of a leader of men and more particularly a leader of young students—which was very important. As for the College, it was essential if such an institution was going to be ultimately sound, that it should be by a process of organic growth. There might be a danger, seeing the enormous field before it, and the tremendous variety of crops at its disposal, that a college of this kind might attempt in the early years to do rather too much. Its chief successes would be won if it went step by step, sending out throughout the world a growing volume of students whose work was recognized. With such a growth, necessarily slow, the college might in due course become the headquarters for University teaching in applied agricultural science for the whole tropical Empire.

Sir Edward Davson commented on the scarcity of trained tropical agriculturists of British birth and upbringing. He had been trying for some time to find a scientific tropical agriculturist whom he could employ to assist those who were working on the properties with which he (Sir Edward) was connected; but he regretted that so far he had been unable to find anyone at home who was qualified for the post On the other hand, he had had a great many applications from Americans with University qualifications and with experience of tropical agriculture. He thought it was a sad reflection that America, whose tropical dependencies were fewer than those of this country, should have the necessary men available when we had not.

Mr. A. E. Aspinall, C.M.G., the Secretary of the College, made a brief statement regarding its financial position, which is certainly causing a very great deal of anxiety. The College owed its inception to the West Indian Colonies which, with one or two exceptions, had come together and most generously contributed one-half of 1 per cent. of their revenue to the support of the College. It was hoped that before very long Jamaica might also come in. The Colony of

Trinidad had not only given one-half of 1 per cent. of its revenue, but also £50,000 wherewith to erect the buildings. That money had already been spent to advantage because buildings had been put up which it was hoped would stand for all time. Gifts had also been received from other quarters towards the building. Now the authorities were looking to other Colonies in the Empire for support. Students had already been sent out to take up appointments in the Sudan, Uganda, Nyasaland and the Gold Coast, and it was hoped that in due course contributions would be received from those Colonies and countries. It would be remembered that the late Lord Milner had inaugurated a fund with the object of providing means for equipping laboratories, building a hostel, and providing an estate, which were so essentially needed; but owing to the Japanese earthquake and the threatened fall of the dome of St. Paul's Cathedral, the response to that appeal had not been so good as had been hoped; but the College had received £29,000, and it was hoped that further contributions would be received when the good work of the College was known more widely. The Rhodes Trustees had given £5000. He particularly endorsed the remarks which had been made about the need for money for a hostel. If money was not forthcoming for that purpose the work of the College would be very seriously checked, if not jeopardized. By October 1st, 1926, accommodation had to be provided for 30 more students, and at present the governing body were in the awkward position of not being able to do that; they simply had not the money. Therefore it was thought H.M. Government should make a contribution, not only of the capital sum for the purpose of the erection of an hostel, but also an annual sum for maintenance.[1]

Recent Company Reports.

Antigua Sugar Factory, Ltd.—The annual report of this company for the year ending September, 1925, recorded a satisfactory season. Although the price of sugar fell heavily, this was balanced by a large increase in the output of sugar, the cane supply being considerably in excess of any previous record. Weather conditions were very favourable, with good rainfall, as a consequence of which the yield per acre was double that of 1924, and the quality of the cane was good. The amount of sugar produced came to 14,626 tons, as compared with 5925 tons in 1924 and 10,308 tons in 1923, and averaged in price £14 15s. 5d., as compared with £22 16s. 7d. and £25 13s. 10d. respectively in the two previous years. The profit and loss account showed a surplus of £44,644; out of this the planters received a supplementary payment of 3s. 6·90d. per ton of canes (making a total average payment of 19s. 7·28d. per ton) which absorbed £22,322; the staff fund was credited with £770, and the balance went to the shareholders' account. These received a dividend of 7½ per cent., absorbing £14,530, and a balance of £7261 was carried forward. A very similar record, as regards crop output, prices and profits, is also shown by the St. Kitts (Basse Terre) Sugar Factory, Limited, the other factory of the Henckell, du Buisson group.

Colonial Sugar Refining Company.—For the half-year ended September 30th last, the Colonial Sugar Refining Company made a net profit of £404,627, which compared with £435,675 in the preceding six months and £338,422 in the corresponding period of 1924. A dividend of 10 per cent. per annum and a bonus of 2½ per cent. per annum were declared (being the same as in the previous six months). A sum of £100,000 was again allocated to the reserve, which now stands at £1,150,000.

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[1] Since the above was written, it has been announced in Parliament that the Government have decided to make a capital contribution of £15,000 towards the cost of erection of the hostel, and a contribution of £3000 towards the general expenses of the College in 1926-27.

Notes and Comments.

Tate & Lyle, Ltd.—The net profit for the year ending last September amounted to £543,138, as compared with £616,784 in the previous year. The dividend was maintained at 13½ per cent for the year, but the amount placed to reserve was £50,000 instead of a previous £100,000, while £52,733 was carried forward as compared with £69,934 in 1924.

The United States Sugar Consumption during 1925.

The consumption of sugar in the Continental United States during 1925 was, according to WILLETT & GRAY, no loss than 5,510,060 long tons, expressed as refined. This compares with the figure of 1924 of 4,854,479 tons, and thus shows an increase of 655,581 tons or 13·5 per cent. It is also the largest U.S. consumption on record, working out at 107·5 lbs. per head. But in the list of world consumptions, it is still a good way behind Australia which is credited with 138 lbs. in terms of raw sugar.

The 13·5 per cent. addition shows itself chiefly by increases in the Louisiana crop, and in Hawaiian, Porto Rican and Philippine sugars imported. Cuban sugars consumed in U.S.A. only increased by 3 per cent. The figures relating to the distribution of the refined sugar business show that the American Sugar Refining Company's five establishments obtained only a slight increase in tonnage, and their percentage of the sugar sold for U.S. consumption actually shows a decrease, being now 19·88 per cent. The other 15 concerns with 16 refineries increased their percentage from 62·72 to 63·24, while the beet sugar producers increased from 15·48 to 16·36 per cent., of the total of sugar going into consumption. The San Francisco refineries increased their output for this market by 27 per cent.

British Beet Sugar Notes.

The Anglo-Dutch group of beet sugar factories are reported to have secured a commanding interest in the Sankey Sugar Co., Ltd., of Earlestown, Lancashire; this latter firm have, as previously reported, decided to combine raw beet sugar production with refining, and will work up the roots grown by South Lancashire farmers. One effect of this transfer of control is that the Sankey refinery ceases to be a member of the British Sugar Refiners' Association, since the van Rossum group which now control it have large interests in Continental refined sugar.

According to press reports the project of the United Sugar Co., Ltd., to erect a second factory, at Selby, Yorkshire, on the site of the Barlow Airship Station, has been abandoned for the time being, one reason given being that insufficient beet supplies have been promised.

Efforts are being made in Shropshire to start a factory in 1927, and the promoters are negotiating with the United Sugar Co. to further the scheme.

Proposals for a sugar factory in the Berwick district are being mooted and the local farmers are being approached with a view to their participation. Similar negotiations are taking place for a factory in Pembrokeshire to serve the Welsh counties of Carmarthen, Cardigan, and Pembroke.

The Spalding factory of the Anglo-Scottish group, which has been completed for some little time, has not yet been able to start operations owing to difficulties with the water supply.

The Wissington factory of British Sugar Manfacturers, Ltd., is reported to have sold its output for the first two years to Messrs. TATE & LYLE on profitable terms.

Fifty Years Ago.

From the "Sugar Cane," February, 1876.

Russell's maceration scheme had been put into operation "Fifty Years Ago" at the Leonora and Bonne Intention factories, Demerara; and in this number of our predecessor a letter from this inventor was reproduced, from which one or two extracts may be made here:—

"It is now a little more than 12 months ago since I made certain trials, both on the small scale and large, which led me to think that machinery might be so adapted as to increase the out-turn from our best cane mills by from 20 to 25 per cent. These experiments I made public, and their publication gave rise to a lengthened discussion, both in our local papers and elsewhere; and the general opinion was pretty much against me, some considering that even if it were possible to extract the juice from the cane, it would be of such an inferior quality as to be unfit to make sugar from; others adopted the exploded theory that the bagasse would be destroyed for fuel, and that any extra yield would not pay for the increased cost of evaporation . . . . . In the meantime, others took up the question in a practical way, and showed that my estimate of from 20 to 25 per cent. on the old working was under the mark. Mr. King, the manager of Plantation Bel Air, in particular, proved that he could make sugar on the large scale from juice of second crushing, and that the bagasse was not so much injured for fuel as was imagined . . . . The controversy did good in so far that, when managers found that from 56 to 60 per cent. was all they were taking out of their canes, mills were braced up, and men sent to return all the badly crushed canes a second time, the result being that mill feeding was better attended to; and it is now rare to see a mill where something over 60 per cent. is not taken out of the canes."

G. C. Stewart, Chemist at the old Cappielow Refinery, near Greenock, published an article on entrainment. He remarked that "if the pan is low set and very short in the swan's neck, ten to one that the liquor drawn from the safe of such a pan will be found on analysis to be much richer in sugar and other organic matter than the liquor drawn from another pan set high and very lofty in the swan's neck." This was a safe hazard on the part of the writer. Figures for the analysis of liquor taken from the save-all of a pan "as old as Howard," showed 11·43 per cent. of sugar, whereas that from a trap in "a modern pan recently constructed" indicated 4·80 per cent.

Several patents were abstracted in this issue, and of these two may be mentioned: The first by Alfred W. J. Mason,[1] of New Orleans, was for a "double carrier of two endless belts which carry the bagasse from the mill in which it has been crushed through an enclosed steam chamber, where it is subjected to a diffusion process by saturating it with steam or hot water or both while passing between a series of kneading rollers. From these it passes to a second 2-roller mill where it is depleted by pressure and passes out in a well-defined fibrous sheet, resembling pasteboard." The second patent had been granted to Richard G. Elwes,[2] of Westminster, London, and was for a char cistern, which "combined the process of upward filtration with the means of admitting from time to time fresh charcoal at or near the point of egress, and of removing spent or exhausted charcoal at or near the point of ingress."

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[1] U.S. Patent, 701,800.

[2] English Patent, 2189 of 1876.

The Growing of Sugar Beet in the United Kingdom.

The Ministry of Agriculture and Fisheries have just recently issued a research monograph[1] which deals with an investigation carried out by the Agricultural Economics Research Institute of the University of Oxford into the costs of production, yields and returns of sugar beet on certain English farms during the 1924 season.

The growing of sugar beet, as is well known, is a comparatively new venture in this country, and farmers are not at present well posted in the economics of the crop. This monograph supplies a good deal of information of the kind that will be needed, and suggests a number of points that require the farmer's attention if the crop is to be a success in his hands. But it must be noted that the investigations relate to the comparatively small acreage of 22,441 sown to beets in the year under review, and the farmers cited were not selected at random but were necessarily confined to those who had kept a record of their operations. Hence the averages obtained were not necessarily those of the crop as a whole.

Under these limitations, however, the monograph deals in detail with costs per acre; costs per ton; yield, sugar content and tare; by-products and residual values of cultivation; labour; capitalization; effect on the farming system; and the future position of the sugar beet crop. As to the costs of production, it is pointed out that labour is the largest single item, averaging £11 9s. 10d. per acre or 53·1 per cent. of the total cost, exclusive of transportation. One notes that the average cost of harvesting was 5s. 6½d. per acre, that the haulage cost to the station averaged 2s. 2½d.; farmyard manures came to £3 2s. 5d per acre; seed was 7d. per lb. (i.e. at cost price); while transport to the factory by rail or road varied widely according to distance and circumstances, being as high as 8s. 4d. per ton of washed roots in some cases, while farmers who used motor transport paid anything between 2s. 6d. and 4s. 5d. per ton depending on the distance covered. Upwards of 75 per cent. of the beets grown had to be sent by rail to the factory. The returns shown varied considerably, most groups showing a profit which in the case of the best group averaged over £4 an acre. But one group having medium to heavy soils and using farmyard manure showed a loss, this being due in the main to a high labour cost and a too heavy manure bill. The best profit was indeed shown on farms using artificial fertilizers only. But averaging all the farms the profit worked out at £1 15s. 3½d. per acre, while in addition the manurial residues were estimated to be £1 16s. 5d. per acre. The sugar content of the roots averaged 16·6 per cent. and varied between 14·2 and 19·0.

A good deal of the pamphlet is taken up with considerations for the farmers of what to do with the by-products, especially the tops and the pulp obtained from the factory; the residual values due to cultivation; the effect on farm routine and system of growing beets; the problems of the labour supply and the chances of securing it. The position of labour is summed up roughly as follows: casual labour may or may not be wanted, depending on the size of farm or acreage grown; what casual labour is at present needed is equivalent to the employment of ten persons full time for 22·7 weeks per 100 acres grown, but is not necessarily additional because of the labour released from other crops displaced by the beets; women and children make good casual labour and work freely, and if well-paid should be attracted to summer work; the campaign period at the factory competes for labour with the lifting period in the fields and calls for co-operative effort between farmers and factories.

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[1] Sugar Beet: The Results of an Enquiry into the Costs of Production, Yields and Returns in 1924. By A. Bridges and R. N. Dixey, of the Agricultural Economics Research Institute. Oxford. Published by Ministry of Agriculture and Fisheries, Whitehall Place, London Price 3s net.

As for the future position of the sugar beet crop, supposing that the subsidy ceases at the end of 1933, the authors of this monograph are frankly uncertain Given an extraction of white sugar of 13·25 per cent. (which was what Cantley obtained in 1924) they calculate the subsidy per ton of beets to be 51s. 8d. till 1927, then 34s. 8d. till 1930, and finally 17s. 2½d. till 1933 when the subsidy under present intentions is due to expire. Thereafter, in the view of Sir Daniel Hall, it would not be safe to count on a price of more than 25 to 30 shillings a ton for the roots instead of, as at present, something round 50s. per ton. Such a price, it seems, would do little to meet the cost of growing the crop to-day, which averages (when allowance is made for manurial values) about 43s. 8½d. per ton. The question then remains: is it possible to effect any further economies?

According to the monograph any great reduction in the farmers' costs must come through better cultivation and handling of the crops. "There is plenty of evidence to show that good yields, both of quantity and sugar content, are dependent to a large degree on sowing the seed at the most favourable time, the correct spacing of the rows and of the plants in the row, the performance at the right moment of the first singling, and the way the subsequent hand-hoeings are carried out. Continental farmers have learnt by experience, aided by research, these finer points of cultivation which go to secure yields combining both quantity and quality. Much remains to be learnt by our farmers in this respect, and it would seem that herein exists the greatest scope for reducing the all-round cost of the crop. . . . Indirectly the farmer's position may be improved if the effect of sugar beet cultivation and its residues makes any appreciable difference in the yields of succeeding crops. It is too early as yet to pronounce that benefits are likely to accrue in this country from the growing of beet. The position is not altogether analogous to that on the Continent where the sugar beet has proved of considerable advantage in increasing all-round yields on the farm. Here root crops on a large scale have been grown for many years, and theoretically the introduction of an alternate root crop would not necessarily create very much additional return."

Over and above the farmer's economies there is the question of increasing the efficiency of the factories and a reduction in the cost of transport, the latter economy being facilitated by a careful spacing of the factories so as to minimize the distance from field to factory. It should not be difficult along both these lines to effect savings in the cost of production. But the farmer is after all the key to the situation and the sooner he makes up his mind to do the crop well and pay attention to cultural details instead of regarding sugar beet cultivation as the "Cinderella" of the farm, the quicker the industry will be put on something approximating to a paying basis.

At the opening of the Kidderminster beet factory, of the West Midland Sugar Co., Ltd., Mr. J. B. Talbot-Crosbie outlined the process in this factory, which has been constructed by Messrs. Duncan Stewart & Co., Ltd., of Glasgow, at a cost of £250,000 and has a capacity of 1000 tons of roots per day. Among the details communicated, it may be noted that this is the first factory in the United Kingdom to employ the Paschen process of continuous juice extraction. Another important innovation is the baryta process of treating the molasses for the exhaustion of its sugar content. Steam is produced in four Vickers-Spearing boilers, each having a steam pressure of 160 lbs. per sq. in., and the power station is equipped with three high-speed Drysdale engines, driving three generators. A Canadian, Mr. Alexander Jacobs, is the works manager, and Mr. H. H. Gonyou his assistant.

The Coimbatore Cane Seedlings in Bihar.

From the Report of the Secretary of the Indian Sugar Bureau for 1924-5, we may safely assume that the Coimbatore seedlings recently introduced into the Bihar sugar making area have secured a firm footing. One of the greatest difficulties in such a project, with the sugar cane, is the absence of seed, and the necessity of distributing cut pieces of a plant liable to injury at every turn and corner; and, in the case of these seedlings, the tonnage required is considerably increased because of their unusually long joints, which, of course, only bear one bud each. The standard seedlings are still, we see, Co 213, 210 and 214; and the local variety over the bulk of the area is the Hemja or Burli, as it is variously named in different villages, a dwarf, a bushy Indian cane of medium thickness, of fair juice but very late in ripening.

The rainfall in recent years has not been all that could have been desired, and this has undoubtedly reacted against the rapid replacement of the local cane by the new seedlings. In 1923, the monsoon (24 ins.) was a complete failure, and was followed by a dry winter; so that, at the normal time of planting (February, 1924) the soil moisture was very deficient. In the trials, the young canes had a very hard struggle during the succeeding hot, dry season (March to July) before the advent of the monsoon rains; the local Hemja gave out completely, while the Coimbatore seedlings withstood the adverse conditions successfully. The 1924 rains were heavy (54 ins.), and the factory season was considerably extended in the areas where the early ripening new seedlings were being grown. This somewhat severe test doubtless assisted in the extension of the planting of these varieties. In 1924 the area covered by them was only 1500 acres, but in 1925 the acreage increased to over 5000. It may, then, be confidently expected that, with this substantial basis from which to draw material, progress will be more rapid in the future. The seed cane required was rendered available by a handsome sum of money contributed by the members of the Indian Sugar Producers' Association, together with 143 acres of land, adjoining the Pusa area, lent by the Government.

But this heavy rainfall proved extremely favourable to the spread of disease among the canes; and a very careful scrutiny of the plots was maintained during the growing season, as to the resistance of the different seedlings. And in this connexion it may be well to consider their parentage. Co 210 and 213 were derived from POJ 213 (a well known mosaic carrier), with Madras seedlings or Kansar (a Punjab variety of the Saretha group) as the probable male parents. Co 214 was a seedling of Striped Mauritius (a Samalkota cane ultimately derived from Mauritius), crossed by a Coimbatore seedling (Saretha × *Saccharum spontaneum*). Co 210 and 213 showed symptoms of mosaic, a root disease, red rot (*Colletotrichum falcatum*), and smut; but far fewer cases were noted in the former. Co 214, on the other hand, was practically free. But, although this is a hardy and early ripening cane, it has a crooked habit (derived from its male parent) and comparatively low tonnage of canes. Co 232, a later introduction from which much had been expected, showed a greater proportion both of mosaic and smut than the rest. It is an early ripener and an erect cane, but it has a high fibre content and is a very poor ratooner; so that it appears to be improbable that it will replace any of the three "standards." An active information campaign was started among the cultivators regarding the importance of the diseases noted, and the means by which they can be held in check. The writer of the Report very justly remarks that practically all cane varieties are liable to disease under certain conditions, and instances Java as a country where nearly all cane diseases are known;

and he gives the comfortable assurance that there need be no nervousness as to the future of Co 213, up to date the best of the Coimbatore series for Bihar. Lastly, 205 (Vellai × *Saccharum spontaneum*), which has proved such a success in the great cane tract of the Punjab, was given in a trial. The Punjab area is much less favourable to the growing of sugar producing canes than Bihar, and this particular seedling is of a more primitive character than the three mentioned above; it has low sucrose and high glucose content, and is late in ripening. But, in spite of this, the author considers that it may be of use on the less favourable soils, while its later ripening may assist in lengthening the milling season.

In view of the recrudescence of mosaic, and the origin of the two best Coimbatore seedlings from POJ 213, attempts are being made to introduce those varieties which are reported to be specially resistant to this disease in other countries. Thus far, Badila and POJ 2714, 2725, 2727 and 2878 (most if not all of Kassoer parentage) have been received and planted under supervision ; while the early introduction of S C 12 (4) is hoped for. A long list of further Coimbatore seedlings under trial is also given.

For mill trials, about 20 acres each of plant canes and ratoons were planted and grown during the year, this work being again financed by a generous allocation of funds by the planters. Some of the results are given below ; but it must be noted that Co 232 appears under a slight disadvantage, in that, when the canes were cut at optimum juice purity, the mill was unable to deal with them, and they had to lie for two or three days before being tested.

	Brix.	Sucrose	Fibre per cent. on cane.	Sucrose per cent. on cane.
Co 232	20·28	15·44	19·27	12·45
Co 214	19·90	16·12	16·98	11·93
Co 210	18·86	14·23	17·76	11·72
Burli (Hemja)	14·23	10·85	13·44	9·39

In the plant canes, Co 213 averaged 600 maunds (82·28 lbs.) per acre on 15 acres, and Co 210 680 maunds on 10 acres. But it is pointed out that these figures by no means exhaust the possibilities of these seedlings. Two planters, for instance, report that they reaped, from Co 213, 1270 and 1200 maunds of cane per acre ; the former figure corresponds with 46·6 tons, as compared with the 17 tons reaped from Hemja. Among the ratoons, Co 210 gave 425 maunds, Co 213 gave 373, while Co 214 gave 300 ; 232 gave a very poor yield, and this appears to be the chief objection to this seedling. Co 280 and Co 275, two of the new seedlings under trial, were planted out during the year under estate conditions, for further examination and trial.

"As regards manurial trials, castor-cake was used as the general manure, but nitrate of soda and ammonium sulphate were also tried on weak patches and were found to be good dressings for forcing the crop. The use of the latter is spreading among large growers in Bihar, while sodium nitrate is being specially recommended for application to the crop intended for use as seed cane. The system of short planting for multiplying seed, evolved by the Bureau, and the use of improved implements for planting and intercultivation recommended, are making satisfactory headway among the growers."

Experiments have been laid down to determine the best time for planting the cane in the local circumstances : it is obvious from what has gone before that, as things are at present, the young cane plants have a very strenuous period to pass through. Probably here, as in many other places, the abundance of planting material at harvest has had more to do with the time of planting than the good of the young canes. The active growth of the cane does not commence in north India till the monsoon rains, and the whole of it has to be secured in the four or five months before the cold weather sets in. In light soil it has been found that when the sets are planted in, say, October, the young canes are far stronger at the beginning of the hot weather than when planted in February, when in a poor monsoon such soils are very dry; and presumably the stronger plants will be better able to withstand the period of stress following. The results of these experiments will be awaited with considerable interest. Spacing experiments are also in progress, both as to distance apart of the rows and number of sets per acre. The latter is a very important point to be settled for the new seedlings: they are specially long-jointed, whereas the local Hemja, like all of the Mungo group, has very short joints.

As to general cultural methods, the author of the Report states that a general improvement is noticeable over the whole tract; and he puts this down to the fact that many of the large growers have followed the suggestions resulting from the cultivation experiments which have been in progress at Pusa for years past. The soil is in the main extremely easy to manipulate, but, none the less, its treatment may be good or bad; and, after years of work, the methods used at Pusa have become stereotyped with regard to sugar cane cultivation. The large growers have in fact acted as demonstrators to the small ones, and the results of this are now becoming distinctly visible. This is interesting, for one of the greatest difficulties in India is the smallness of the areas individually cultivated, and the unwillingness and, indeed, inability of the cultivators to try experiments themselves.

The great bulk of the present Report is taken up with the agricultural side of the Secretary's work: industrial and commercial matters are treated in very short paragraphs, but the work appears to be going on satisfactorily in these directions as well, and the usefulness of the Bureau is abundantly evident. He points out that the year 1924-25 was a very bad one for the industry. For reasons already given, there was a retrenchment in the area sown, and he mentions that in the United Provinces alone this shortage amounted to over a quarter of a million acres as compared with the previous year. As to Bihar, the factories did not obtain sufficient cane to keep them profitably working. Coupled with these internal troubles came the fall in world prices of sugar, and the net imports of foreign sugar entering the country rose, in consequence, from 375,720 tons in 1923-4 to 648,975 in 1924-5. Owing to the decreased quantities of gur and the consequent high prices, it was quite impossible to utilize this, at best, unsatisfactory material for factory work to make up the deficiency. We note that, while many are just now crying aloud for increased tariff protection, the author takes his stand rather on "efficiency in the field, efficiency in the factory and efficiency all round in organization." These, it must be conceded, more than any others are the factors which, in the past, have made it so difficult and even impossible for India to stand in competition against imported sugar.

C.A.B.

Dr. O. **Spengler**, of Dessau, has been chosen as the successor of Dr. A. **Herzfeld**, as Director of the Institut für Zuckerindustrie, of Berlin, which appointment has been confirmed by the Prussian Minister of Agriculture.

Mr. F. O. **Licht** has made a further small reduction in his estimate of the European beet crop, his latest total being 7,422,000 tons, against 7,482,000 previously, and 7,078 000 in the previous season. The latest estimate includes Czecho-Slovakia, with 1,550,000 tons, Hungary 160,000, France 755,000, and Belgium 340,000.

Froghopper Pest of Sugar Cane in Trinidad.

In the article appearing under this title in the November issue of this journal (p. 585) reference was made to a recommendation that a committee should be appointed in Trinidad to carry out investigations extending over several years with a view to a more complete understanding of the nature of the froghopper pest, and in the hope of it being possible to devise means for its control.

From information which has recently come to hand it appears that the proposed committee has now been appointed, and has already made progress in planning some of the lines of investigation which it is thought well to put in hand with as little delay as possible. This committee consists of the Hon. W. G. FREEMAN, B.Sc., A.R.C.S., Director of Agriculture (Chairman); Dr. H. MARTIN LEAKE, M.A., Sc.D., Principal of the Imperial College of Tropical Agriculture; Sir FRANCIS WATTS, K.C.M.G., President of the Agricultural Society of Trinidad and Tobago; Mr. A. CORY DAVIES, President of the Trinidad Chamber of Commerce; Mr. W. NOWELL, D.I.C., Assistant Director and Plant Pathologist, Department of Agriculture; and a number of Estates Managers and Attorneys.

The committee met for the first time on November 4th, and after settling certain preliminary details it was agreed to appoint several sub-committees, the terms of reference to which were "to prepare a programme of the lines of work, to report how far present facilities are sufficient and to make recommendations, financial and otherwise for the execution of the programme." The three sub-committees promptly made recommendations with regard to the problems which, at the outset, it seems desirable to start work upon, and they make suggestions as to the scientific workers whose services appear to be necessary. For the most part it would seem that it is recommended that the investigations should be undertaken by members of the staff of the Imperial College of Tropical Agriculture and of the Agricultural Department of the Colony. In the case of the soil investigations, however, the sub-committees are "of opinion that for the carrying out of the required investigations it is essential that the whole time services should be obtained of a man thoroughly experienced in recent soil research, and that little progress in this connexion is likely to be made until the services of such a man are available."

The recommendations of the several sub-committees are too lengthy to be reproduced here in full; suffice it to say that the entomological sub-committee makes recommendations for the study of the causative insect in all its phases; for the study of the sugar cane in relation to the insect and methods of destruction of the insect, consideration being given to *sprays*, *dusts*, *traps* (light and other forms), *parasites* both insect and fungus, and the use of birds. A special memorandum by Professor ASHBY on the fungus control of froghopper, in which an account is given of the Green Muscardine fungus and the Empusa fungus, is included.

The Agricultural Sub-Committee makes recommendations with reference to the use of cover crops for long and short term fallow; the possibility of adopting rotation crops; means for increasing the supply of pen manure and pen manure substitutes; the provision of fodder for stock in the wet season; the best ways of disposing of trash and improvements in drainage.

The Soil Relations Committee recommend a survey of soil types of the cane-growing regions, including a systematic study of the acidity or alkalinity (*pH*), and the determination of the bases in the soil which are available to plants, i.e. the exchangeable bases. This sub-committee also makes a number of recommendations of points for enquiry, including the correlation of the acidity of the soil with the yield of cane; liming experiments; the determination of the water requirement of the sugar cane; the determination of the water-supplying power of the soil; the effect on tilth of the addition of organic matter in various forms, the effect on soil tilth of burning and of burying cane trash, and the general effect of fertilizers on liability to and recovery from froghopper attack.

In addition to the work planned by these sub-committees it is understood that a large amount of work is being undertaken by the staff of the Agricultural Department in collecting and filing for study and reference general information concerning rainfall and other climatic conditions; the incidence of froghopper attack on the various estates throughout the island; the yield of sugar cane from individual fields over as wide an area as possible, and generally accumulating information likely to be required by those investigating the problems concerned.

It would appear that a carefully planned campaign is being organized covering a wide field and making use of the activities of a large number of trained scientific workers; this is evidently wise, for the problems involved in the control of the pest are extremely complex and call for combined study on the part of a wide range of investigators; it is recognized that the matter is not merely an entomological one but, in addition to investigations concerning the causative insect, it is essential to study climatic conditions, to investigate the sugar cane in order to discover what factors encourage attack or tend to confer immunity, and also to study a wide range of soil subjects including not only those of a chemical or physical nature, but also including a wide range of subjects related to the tilling and manuring of the soil and the use of supplementary crops.

With the concentration of such a skilled and active body of workers on this special problem it is to be expected that interesting and useful results will soon be forthcoming, and that in process of time remedies will be found for the troublesome pest under investigation; at the same time it is not too much to hope that substantial additions to knowledge will result from the wide range of investigations contemplated, and that general benefits will accrue to the sugar industry in other directions. The work of this committee of investigators will be followed with interest by those connected with the sugar industry not only in Trinidad but throughout the world, and this interest will be enhanced when it is remembered that it is the intention to provide means for continuing the work of the committee for a number of years.

Early in the New Year a number of Honours were bestowed on various persons closely associated with the work of the Imperial Exhibition at Wembley which ran for two seasons. Among these, we note with pleasure that Mr. A. E ASPINALL, C.M.G., the indefatigable secretary of the West India Committee (whose labours were greatly extended by the Colonial Section of the Exhibition) has been made a Commander of the Order of the British Empire (C.B.E).

The feat of the Badische Anilin & Soda Fabrik in producing methanol (synthetic methyl alcohol, 99 per cent., containing little or none of the ordinary impurities) is thought by some to threaten the ruin of the American wood distillation industry. It is produced from mixtures of carbon monoxide (1 volume) and hydrogen (2 volumes), using metallic catalysts,[1] and the cost of making it is rumoured to be 12-18 cents. per gallon (U.S.). Such a cheap spirit, though of lower calorific value than ethyl alcohol, may affect the problem of motor fuel production. Its development may therefore be watched with some interest. The Patart process in France is being exploited, three plants with a potential capacity of about 11,000 tons per year of methyl alcohol being under consideration. A production cost of only 1·30 franc per kg. is estimated.

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[1] *Cf.*, U K. Patent, 239,714 in the name of the Badische A. & S. F.; U.S P., 1, 201,850, held by the Chemical Foundation, and also French Patent, 540,543, in the name of Georges Patart, who claims priority over the B A.S.F. See *Industrial and Engineering Chemistry*, 1925, 17, No. 8, 859.

Flue Gases and Draft.

By P. H. PARR.

Some time ago the author wrote on "The Calorific Value of Bagasse"[1] and the present article may be regarded as a supplementary one, dealing chiefly with the products of combustion and their disposal.

In actual practice, boiler flues and chimneys are usually decided by old rule-of-thumb methods, which, as a matter of fact, generally give satisfactory results in working, but may also cause a considerable amount of trouble in some cases, especially where an old empirical formula is applied by a young engineer who is not acquainted with its limitations.

It is very desirable to be able to estimate rapidly, and with fair accuracy, the volume of the flue gases under different conditions, and the draught to be expected from a particular chimney. The first is fairly easy, but data are lacking to give a really satisfactory answer to the second, since it depends very greatly on the *mean* temperature of the gases in the chimney, which is appreciably different from the temperature at the base.

We will first consider the volume of the flue gases, which may be taken to consist of carbon dioxide, water vapour, oxygen, and nitrogen. Now at N.T.P. (normal temperature and pressure, or freezing point and 760 mm. mercury), the volumes of 1 lb. of carbon dioxide, oxygen, and nitrogen are 8·1, 11·2, and 12·8 cub. ft. respectively, and they may be considered to be perfect gases, so that their volumes will vary directly as the absolute temperatures (deg. Fah. + 460), and inversely as the absolute pressures.

Water vapour is far from being a perfect gas, and of course condenses to water far above 32°F., but still, so far as present purposes are concerned, which chiefly deal with flue gases at 300-700°F., it is quite near enough to assume that water vapour is a gas with an N.T.P. volume of 20 cub. ft. per lb.

Using these values, and taking the amounts of the products of combustion from the article mentioned above, then the N.T.P. volume of the gases from 1 lb. of fibre when burned with 100 per cent. excess air will be :—

		Cub Ft.
CO_2	1·723 × 8·1 =	14
H_2O	0·567 × 20 0 =	11
O_2	1·290 × 11·2 =	14
N_2	8·638 × 12·8 =	111
	Total	150

Similarly, the N.T.P. volume of the gases from burning 1 lb. of sugar with 100 per cent. excess air will be 133 cub. ft., and from 1 lb. of air-dried wood 120 cub. ft.

The N.T.P. volume of the gases from 1 lb. of bagasse, taking the composition decimally, and noting that moisture = 1·00 — (fibre + sugar), will therefore be :—

$$150 \times \text{fibre} + 133 \times \text{sugar} + 20\,(1 - \text{fibre} - \text{sugar}),$$

which reduces to :— $130 \times \text{fibre} + 113 \times \text{sugar} + 20$ cub. ft. (1)

For instance, taking an average bagasse as being composed of 47 per cent. fibre, 5 per cent. sugar, and 48 per cent. moisture, the N.T.P. volume of the flue gases will be :— $130 \times 0{\cdot}47 + 113 \times 0{\cdot}05 + 20 = 86{\cdot}7$

cub. ft. per lb. of bagasse, and at an ordinary chimney temperature of 550°F., this will be increased to :—

$$\frac{86{\cdot}7 \times (550 + 460)}{32 + 460} = 178$$

cub. ft. per lb. of bagasse.

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[1] *I.S.J.*, 1922, p. 13, *et seq.*

A factory crushing 1000 tons of 12 per cent. fibre cane per 24 hours will have 10·6 tons of the above bagasse per hour, which means a chimney gas volume of 10·6 × 2240 × 178/60 = say 70,000 cub. ft. per min., and this is the volume which an induced draft fan would have to handle with a waste gas temperature of 550°F.

The velocity of the gases through the chimney varies from about 1200 ft. per min. for small plants to 2000 ft. per min. for very large ones; taking 1500 ft. per min. for this case, the chimney should have an area of 70,000/1500 = 47 sq. ft., or a diameter of 7 ft. 9 in. or 8 ft.

It is useful to note that, when flue gas analyses are made by the Orsatt or other apparatus, the water vapour is condensed and ignored, so that the carbon dioxide percentage refers to the permanent gases only—CO_2, O_2, and N_2—and with practically all bagasse, the per cent. of CO_2 will be between 10·0 and 10·5 for 100 per cent. excess air. Moreover, for all carbohydrates, the amount of excess air is given accurately by dividing the percentage of oxygen in the waste gases by that of carbon dioxide (volumetric analysis being here understood).

The next question is as to the draft given by a chimney, which is of course determined by the difference of weight between the hot gases inside the chimney and the cold air outside.

As was indicated in the article mentioned above, the total weight of the gases from the combustion of 1 lb. of fibre, with 100 per cent. excess air, is 12·218 lb.; and since their N.T.P. volume is 150 cub. ft. as shown above, the N.T.P. density is 12·218/150 = 0·08145 lb. per cub. ft. Similarly, the N.T.P. density of the gases resulting from the combustion of sugar is 0·08095 and from wood 0·08037 lb. per cub. ft., whilst the (hypothetical) density of the water vapour is 1/20 = 0·05 lb. per cub. ft.

For 1 lb. of bagasse, the total weight of the gases will evidently be:—

$$12{\cdot}218 \times \text{fibre} + 10{\cdot}766 \times \text{sugar} + (1 - \text{fibre} - \text{sugar})$$

or:—

$$11{\cdot}218 \times \text{fibre} + 9{\cdot}766 \times \text{sugar} + 1 \qquad (2)$$

giving 6·76 lb. for a normal bagasse of 47 per cent. fibre and 5 per cent. sugar. The N.T.P. volume of these gases has been shown above to be 86·7 cub. ft., so that the N.T.P. density will be 6·76/86·7 = 0·07796 lb. per cub. ft.

For the air outside the chimney it is reasonable to assume, for sugar factory conditions, a normal temperature of about 80°F. and a humidity of about 60 per cent., or a dew-point of about 65°F., as indicated by the author in the article on "Air, Humidity, and Drying,"[1] and for air of this quality the N.T.P. volume is 12·4 cub. ft. per lb., and the N.T.P. density 0·08065 lb. per cub. ft.

If T_1 is the absolute temperature of the gases inside the chimney (deg. Fah. + 460), then for the gases from average bagasse the weight in lb. per cub. ft. will be:—

$$\frac{0{\cdot}07796 \times 492}{T_1} = \frac{38{\cdot}36}{T_1}$$

and if T_2 is the absolute temperature of the external air, its density will be:—

$$\frac{0{\cdot}08065 \times 492}{T_2} = \frac{39{\cdot}68}{T_2}$$

lb. per cub. ft.

The difference between the weights, in lb. per sq. ft., of the hot gases in the chimney and the external air will therefore be:—

$$\left(\frac{39{\cdot}68}{T_2} - \frac{38{\cdot}36}{T_1}\right) \times H \qquad (3)$$

where H is the height of the chimney in feet.

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[1] *I.S.J.*, 1923, p. 16 *et seq.*

It is usual to measure draft in inches of water, and since 1 in. of water is equal to 5·193 lb. per sq. ft., the pressure difference, or draft, in inches of water, will be:—

$$\left(\frac{7{\cdot}64}{T_2} - \frac{7{\cdot}39}{T_1}\right) \times H \qquad (4)$$

As an example, if the chimney gases are at an average temperature of 500°F., and the air is at 80°F., then a chimney 120 ft. high will give a draft of:—

$$\left(\frac{7{\cdot}64}{540} - \frac{7{\cdot}39}{960}\right) \times 120 = 0{\cdot}775 \text{ ins. of water.}$$

Experience shows that green bagasse cannot be burned satisfactorily or economically with a draft of less than 0·5 in. water, even in the smallest plants, which shows that, with gases at 500°F., which is reasonable, no chimney for a sugar factory should be shorter than 80 ft., even if serving nothing but one small boiler of 5 or 6 ft. diam. In general, a draft of 0·75 in., calling for a chimney about 120 ft. high, is satisfactory for medium-sized sugar factories crushing less than 1000 tons of cane per day. With large factories, a draft of not less than 1·0 in. should be allowed, which is sufficient to give a reasonable flexibility in working. If economizers are installed, an additional draft of at least 0·2 in. will be required, and it is better to allow for 0·25 or 0·3 in.

It should be noted that the mean temperature of the gases in the chimney is very appreciably lower than the temperature at the base. There are very few data available on this point, and the author has only two definite records, both taken by steeplejacks when repairing chimneys. In one case, with a steel chimney about 90 ft. high, amongst buildings, so that two-thirds was protected against wind, and with a bottom temperature of about 460°F., that 60 ft. up was about 30° F. lower. In the other case, of an 80 ft. exposed brick chimney, taking gases at about 800° F. from a re-heating furnace, the temperature loss to the top was about 200° F. In the absence of better data, the mean temperature of the gases in a chimney may be taken as 5 to 10 per cent. lower than the flue temperature.

The reason why an unduly large chimney gives a sluggish draft is that, owing to the low velocity, and consequent long time during which the gases remain in the chimney, the cooling is increased above the normal, thus reducing the draft.

It must be noted that the above calculations for draft all refer to plants which are not much above sea-level, so that the normal barometric height is about 30 in. of mercury. For factories up in the hills, as in some sugar producing countries near the equator, the barometric height is reduced roughly by 1 in. for each 1000 ft. above sea-level, and the draught is reduced in exactly the same proportion, so that the 120 ft. chimney of the above example, giving a draft of 0·775 in. at sea-level, would only give 0·775 × 26/30 = 0·67 at a place in the hills 4000 ft. higher. Moreover, the volume of the gases is increased inversely as the barometric height, so that, where a 6 ft. × 120 ft. chimney is required at sea-level, a 6 ft. 6 in. × 140 ft. chimney is required for the same duty at a height of 4000 ft.

For the larger sugar factories, it is now common practice to install induced draft fans, with chimneys only about 80 or 100 ft. high, and in this connexion it it may be well to mention that several of the fan makers have got into a bad habit of offering fans to give 2 in. draft. It is not always understood that, the higher the draft, the smaller, and thus cheaper, is the fan, though of course the power required for operation is greater.

The author has heard a number of serious complaints regarding fans which have been put in to give 2 in. draft, as a large amount of small bagasse is drawn through unburned, with many sparks. In general, it will be found far more satisfactory to insist on a fan large enough to deal with the gases at a draft not exceeding 1¼ in., or 1½ in. at the very outside; and the slight extra cost will be far more than repaid by the more efficient operation of the furnaces, and the lower power consumption of the larger fan.

Report on Cane Milling in the Philippines.[1]

By WILLIAM WYLLIE.

MILLING EFFICIENCY *vs.* CAPACITY.

Average milling efficiencies have not improved due to poorer quality of cane and increased grinding rate, several centrals reporting 20 per cent. to 30 per cent. over rating. Grinding cane at this over-rated capacity and endeavouring to accomplish a higher extraction are not welcome features to mill engineers.

Philippine centrals seem to lack preparatory machinery, most centrals having but one set of cane knives per mill. We must have efficient machinery preparing the cane prior to crushing. Double sets of cane knives, double crushers or Searby shredders would fittingly answer this purpose, especially the latter. That the rind in cane is not sufficiently broken up is one important reason why our mill efficiencies are so much lower in comparison with the Hawaiian standard.

MILL ROLL GROOVINGS.

Coarse roll grooving seems to be the only method at present to improve capacity as well as extraction. Two inches to one inch pitch with 50° angle grooving on forward mills, finishing with three-eighths pitch at 45° on the latter mills are used. Messchaert juice grooves should be installed on feed rolls; and, on exceptionally coarse grooving, the juice grooves should always be installed on top of groove or tooth, never at the base. Lateral grooving cut across roll shells assists feeding considerably; originally the depths of these grooves were half the depth of the surface grooves, but last season these grooves were deepened at Talisay to ⅛ in. under base of surface grooves, making a square cut groove $\frac{3}{16}$ in. wide × $\frac{7}{16}$ in. deep. The above lateral grooves were installed on rolls having ⅜ in. pitch surface grooving and proved very satisfactory, lasting throughout the crop.

POLISHING OF ROLLER SHELLS.

Polished roll shells are usually attributed to a hard texture of material, but this statement in some cases is very misleading. The polished effect usually comes from slippage or from grinding cane smeared with mud and sand. Victorias Milling Co. had this unfortunate experience last season, and in consequence reduced their tonnage almost 200 tons cane per day for a short period. Another possible cause of roll polish is tight scrapers on roll shells, especially where the steel scrapers are used. In some cases specially strong backs have been attached on mill housings for the additional tightening of rods. This idea may be of some value with exceptionally coarse grooved roll shells; but, nevertheless, should the scrapers be tightened beyond a reasonable tension, a polished effect develops on soft and hard shells alike. Thence the shell is condemned as being of hard texture and not up to manufacturer's guarantee. Scrapers should only have tension enough to partly clean roll shells, small particles of bagasse clinging on to surface grooving of shell indicating the proper tension and at the same time producing a nap or rough pitted surface on shell which the operating engineer should always try to maintain.

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[1] Abridged from Report of the Committee on Manufacturing Machinery, Philippine Sugar Association, 1925.

Roll shell texture, whether soft or hard, will develop a brilliant polish if the cast iron is close grained. A shell with a beautiful polish and termed hard while operating has proved to be exceptionally soft in regrooving, using the same tool throughout the job. Shells which had been considered soft while operating, producing practically no polish and considered good feeding rolls, on regrooving show the texture of shell to be hard, and require several grooving tools to complete the job. On examining this type of shell through a microscope, coarse grained material can be observed. Open or coarse grained cast iron, not too hard, is the proper texture.

MILL SETTINGS.

Mill settings and returner bar settings are generally left to the judgment of engineers in charge. Capacity being the first question to be considered with P.I. centrals, the usual practice is to open up mill settings, or decrease hydraulic loads, and so increase surface speed of rolls, etc., and accomplish increased capacity. The same can be accomplished by lining under hydraulic jacks, in other words allow the top rolls to float. This immediately increases openings on feed and discharge rolls alike.

During the general off season repairs returner bar settings should be carefully checked and properly set. The steel bar must first be levelled and lined square with top roll centre line. The cast iron or steel toe should have a happy medium clearance of about 1¼ toe, 1½ centre, 1¾ heel off top roll shell, and not more than ⅜ in. clearance from back-roll when new. Provision for adjustments in the form of steel liners should be arranged under cast steel chairs for bar bearing blocks. This is important in facilitating adjustments of bar toes. Should these returner bar toes be properly set, for determined mill openings, suitable for a desired tonnage of cane, no adjustments should be necessary throughout the crop and no trouble anticipated. The bar tension bolts should not be drawn up too tight, otherwise a polished effect develops as with roll scrapers; and, furthermore, the toes wear down rapidly, a replacement being due which is expensive during the milling season. Increased ratios from first to last mills do not seem necessary, the writer rather preferring surface speed of all mills to be the same. Two mill trains, consisting of two roll crushers and nine-roller mills, undoubtedly are the best combination. A long train of equal capacity to that of double mills does not respond the same, when increased capacities are desired.

CANE MILL KNIVES.

A new type of cane knive named "Ha-Ko-Hi," made locally, proved very satisfactory. The holders are designed to fit on shaft of existing Hind hubless type, which makes the installation inexpensive. These holders are made of two $\frac{3}{16}$ in. steel plates with parting piece in centre to allow clearance for circular saw steel blade which represents the knife. Fifteen knife-holders on shaft with saw steel disc knife are attached on each end, making a total of 30 knives, or, if double hubs are incorporated, 50 knives can be attached on one shaft. The knife is held and pivots on a centre bolt; and four additional holes are drilled on the circular knife, 3¼ in. radius at 90° apart. Two of these holes are utilized for a locking device consisting of flush through bolts in knife holder conforming with two holes on knife. The improved feature of these knives is that they can be turned around 90° or 180°, etc., if necessary, producing a new cutting edge at any desired time. While the knives are operating, the trailing edge of the disc produces a self-sharpening effect.

JUICE STRAINERS.

Two standard sized Peck strainers installed last year produced very gratify-results, especially the one straining cutter and first mill juices. This strainer was equipped with 80-mesh Monel metal screen, rated capacity 16,000 galls. juice per hour, or, on cane, approximately one ton per min. After a few days' demonstration the juices from both tandems were added with an average increased capacity of 40 per cent. over rating. Several tests were made of the suspended matter removed which averaged approximately 50 per cent. It is very important to keep the filtering cloth clean. Hot feed-water applied on outside of screen by steam hose under pressure, was found to be the most effective, this being applied daily during 15 minutes' time, the juice being by-passed during this period. No mill stoppage is necessary. Boiling out with caustic soda does not seem necessary and steam evidently cooks and bakes the bacteria and gums on to wire cloth. The other strainer was used on the secondary juices; next season we anticipate using both on crusher and first mill juices, using finer meshed screens throughout.

For centrals not equipped with the Petree process but using Peck strainers, the writer would recommend experimenting with wire cloth of a mesh depending on the local mud-press condition, as determined at mud-press station. Our Hawaiian friends have demonstrated that by liming the settlings to a distant alkalinity and bringing to a boil, a perfect cake can be produced with better filtration.

An automatic Richardson bagasse scale, recommended by Mr. HERBERT WALKER, will be installed between last mill and bagasse elevator for the purpose of weighing bagasse.

Loss of Sugar by Inversion in Sugar Factories in Northern India and its Prevention by Antiseptic Measures.[1]

By C. M HUTCHINSON, C.I.E., B.A.,
Imperial Agricultural Bacteriologist,
and
C. S. RAMAYYAR, B.A. First Assistant.

At the suggestion of the Superintendent of Factories, Muzaffarpur, India, we visited and examined the conditions in two of the sugar factories in the vicinity of Pusa with a view to elucidating the causes of the inversion known to occur in the cane juice. A series of samples was taken from various points in the passage of the juice from the rolling mills to the liming tank and the filter-presses.

Seven samples were taken in sterile test tubes from :—(1) the main channel of roller mill; slime and juice; (2) slime from outside of rotating sieve; (3) slime from inside of rotating sieve; (4) juice before liming at entry of main into liming tank; (5) filtrate from first filter-press; (6) filtrate from second filter-press; (7) juice from liming tank.

These were plated on ammonium nitrate agar. Then platings were made from the above samples on the sucrose agar medium recommended by GREIG SMITH,[2] after which the samples were plated again, this time on cane juice agar.

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[1] Bulletin No. 163, Agricultural Research Institute, Pusa (here abridged),

[2] GREIG SMITH. *Proc. Linn. Soc. of New South Wales*, 1901, pp. 654-684.

In ammonium nitrate agar only moulds and yeasts grew, including colonies of the Cerevisiæ type of yeast. On sucrose agar several species of bacteria were found; while moulds were rather fewer and yeast colonies appeared late; cane juice agar was favourable to the growth of certain slime-forming bacteria, yeasts being also abundant. Pure cultures from the various plates were made on the respective agar media.

Having isolated the various organisms, their power to invert sucrose solution was next tried. For this purpose, Greig Smith's medium (which contains 10 per cent. of sucrose) was heated in the Koch sterilizer for three days in flas s containing 100 c.c. each and inoculated from the sucrose agar slants. Incubation was carried out at room temperature (30°C.) and the invert sugar estimated by Fehling solution at the end of four days. In the case of two yeasts, 8·8 and and 6·6 grms. of invert sugar had been formed.

In order to determine the rate of inversion by some of these organisms during the earliest periods immediately following inoculation, three which had been found to produce the greatest amount of invert sugar were selected and inoculated separately into 500 c.c. of the same medium.

These were incubated at room temperature (about 30°C.) and tested for invert sugar with Fehling solution after different intervals. It was then found, however, that under these laboratory conditions it takes at least six hours for these organisms to produce invert sugar in measurable amounts. Only 5 to 7 per cent. of the original sugar was inverted in two hours. Yeasts (*Cerevisae*), moulds and bacteria (probably of the *Subtilis* group), appear to be concerned in this inversion.

Evidently the practical significance of such inversion as is shown to occur in presence of above organisms, must depend on their presence in contact with the cane juice in very considerable numbers. This aspect of the case can only be dealt with by experiments designed to reproduce mill conditions in this respect; e.g., juice from the rollers passing along channels coated with bacterial and mould slimes, and through a rotating sieve similarly coated, under which conditions it is possible that a relatively short time of contact might produce inversion on a scale of practical importance.

Dr. HALDANE, Chief Chemist to Messrs. Begg, Sutherland & Co., has shown the effects of the use of a hypochlorite antiseptic in reducing bacterial and other fermentation in the juice. This antiseptic, "E.C.," made by the electrolysis of brine, is stabilized by a process worked out in this laboratory making it effective as an antiseptic in the presence of an excess of organic matter; its cheapness allows of its use on the large scale required in a sugar factory. Its available chlorine concentration is about 2 per cent. and it is diluted to 1 part in 500 for use in the factory, giving a chlorine strength of 1 part in 25,000.

This dilute solution was used to sprinkle the mills before crushing, while the bagasse carrier was also sprinkled occasionally during the crush.

Striking results were thus obtained. Before the use of "E.C." the invert sugar and acidity values were 1·25 per cent. and 23·4 c.c. of N/100 NaOH for 10 c.c. of juice. But after its use, these figures became 0·88 per cent. and 15·9 c.c.

It is clear from these figures that the rapidity of inversion taking place in the relatively short time available for this action must depend upon a heavy coating of bacterial slime containing an active population of acid-producing organisms over a large proportion of the surfaces of the rollers and of the channels carrying the juice from the rollers to the liming tanks and particularly in such parts as the rotating sieves. Elimination of this bacterial infestation and prevention of its recurrence should be aimed at and should result in diminishing considerably the inversion between crushing and liming which Dr. HALDANE's figures show to occur on a serious scale.

Inversion in cane juice as a result of the presence of micro-organisms will occur: (1) as a direct result of the metabolism of the organism concerned; and (2) by the acid produced. These two methods of producing inversion will in most cases be characteristic of different classes of organism and are not necessarily mutually antagonistic, under the conditions obtaining in a sugar factory.

The actual rate of inversion observed in the experiments with the pure cultures of organisms isolated at first sight suggests that the effect of operating over the short periods during which the juice is subjected to their influence could not be of material importance. Dr. HALDANE's figures, however, show that the reduction of this rate of inversion as a result of the use of the antiseptic "E.C." is sufficient to make differences of practical importance.

It is probable that the mass infection existing in the mills and channels leading from them to the liming tank is a cumulative one, owing to its effectiveness to a rapidly gained condition similar to that obtaining in a sewage filter-bed, where the bacterial action when fully established is of a much higher order than that which is found in pure cultures of the same class of organisms. If this conclusion is correct, then the problem of reducing inversion by the use of antiseptics is greatly simplified, as it is no longer necessary to aim at a high degree of sterilization of mills and channels, but merely at the suppression of the growth to such a degree as to prohibit an effective rate of inversion, or alternatively to ensure the prevention of the establishment of a mass infection of the surfaces in contact with the juice. This latter alternative, which appears the more important of the two, would suggest the advisability of sterilization of the mills and channels at frequent intervals rather than any attempt to introduce antiseptics into the juice itself.

Mr. NOEL DEERR has pointed out that for a number of years past it has been recognized by cane sugar factory operators that an undetermined but distinct overhead loss occurs due to micro-organic activity; further, that this is especially pronounced in the process of extracting the juice from the cane in multiple trains of mills, where some portions of expressed juice may remain as long as 10 minutes before going to the next step in process, opportunity being thus afforded for the mass action of micro-organisms, and any means for maintaining a milling plant sterile will be of value to the industry.

Lime generally used is not an efficient antiseptic; frequent washing down delays the operation of the mill; while formalin, useful in some cases, is in general too expensive. It seems highly probable that a cheap and efficient antiseptic such as "E.C." will fulfil a valuable purpose in the sugar factories. Preliminary experiments made during the 1924-25 season have confirmed this view, and it will be systematically used in the factories operated by Messrs. Begg, Sutherland & Co., during the ensuing 1925-26 crop.

It appears to be thought by many that BREWSTER and RAINES[1] were the first to apply hydrogen-ion concentration determinations in the examination of sugar-house products. But it will be found on reference to the indexes of the *I.S.J.* that in 1920 F. J. BATES and associates[2] published an abstract of a paper in which they described the application of the CLARK and LUBS indicators to the analysis of refined sugars, finding "great irregularity of relation of the H.I.C. to acidity by titration." Another reference was published later.[3] It is hoped by chemists that the Bureau of Standards may shortly see their way to release for publication this valuable, original paper by Dr. BATES and his co-workers.

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[1] *I.S.J.*, 1923, 88-93. [2] *Ibid.*, 1920, 654. [3] *Ibid.*, 1921, 135.

Electrification of Sugar Plantations.[1]

By GEORGE L. TRIST.

The use of electricity for power and light has become so general on many plantations in late years that it is no longer an experiment. Cheaper first cost, flexibility, and low maintenance costs are responsible to some extent for its rapid growth. It is considered that 3-phase, 60-cycle, 440 volts, is correct for the factory, stepping the voltage up in ratio to the length of transmission lines for outside installations. In selecting the prime movers, a study should be made of the steam requirements in the boiling house, selecting a non-condensing unit capable of operating with good steam economy against the back pressure of the system. Providing the K.W. output of generator can be used, this unit should be of ample capacity to furnish the required amount of steam. Additional units, if required, would be condensing, designed for best possible steam economy.

Exciters.—One motor generator set of ample capacity to care for the entire station is preferred. There should also be one steam-driven exciter set to care for the station in case of emergency, or to start up the station when all power is off with no outside supply.

Switchboards.—No set rule can be applied in laying out the switchboard. Care should be taken that plenty of room be allowed for getting around and behind to make repairs to apparatus, reducing hazard of electric shocks to a minimum. Usually it is good practice to mount the field rheostats directly below or above the machine panels, and oil circuit breakers about midway between panels and back wall, using remote control for operation. The panels should be not less than 6 ft. and preferably 8 ft. from the wall.

Selection of Motor Feeders.—Motor feeders should be of ample current-carrying capacity, consideration being given to distance and line drop. Low voltage at the terminals of induction motors is poor practice and false economy. Much better operation will be obtained by applying correct voltage.

Overload and Low Voltage Release.—Induction motors, 5 h p. and under, may be safely started by throwing directly across the line, almost any approved double throw safety switch being satisfactory. Motors above 5 h.p. should be provided with some form of oil-immersed starter, auto-starter, compensator, or magnetic. The magnetic starter is preferred. Whichever is chosen should be furnished with overload and no-voltage release relays. The overload relays, being set for full load of the motor, will become operative in the event of an overload and automatically return the starter to the off-position, eliminating the possibility of burnouts from single phase operation, which often occur where fuses are the only protection provided. The low voltage relays become operative with extremely low voltage, or upon power failures, automatically returning the starter to the off-position. With return of power, there is no danger of full line voltage being applied, which is not only dangerous to the motors, but objectionable at the power plant.

Motors.—The squirrel cage induction motor is applicable to almost all drives in the factory, except in a few cases where variable speed is required, when it is advisable to install the wound rotor motor with suitable resistance and control apparatus. The squirrel cage motor is the cheaper and requires the minimum attention on account of the absence of commutator, slip rings, brushes, or brush rigging.

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[1] A Paper presented at the Annual Meeting of the Hawaiian Sugar Technologists, October, 1925.

Sizes of Induction Motors.—Induction motors should be run as near full load as possible at all times to guard against the low power factor so prevalent in many factories. This condition is extremely bad when the power end is limited. The generating equipment becomes overloaded with wattless current, resulting in overheated machines and poor regulation over the entire electrical system. In factories with limited power-house facilities, it is advisable that motors of 75 h.p. and up be of the wound rotor type to limit starting current to a minimum and prevent violent voltage surges over the system. In factories not limited at the supply end, motors over 200 h.p. should be of the wound rotor type. This motor, on account of brushes and slip-ring arrangements, should be installed in a clean place.

Synchronous Motors.—Too much attention cannot be paid to the subject of the power factor of the mill load. A low power factor cuts down the effective capacity of the generating plant, because it requires the generators to supply a large amount of wattless current, which is of no value to the system. Voltage regulation is poorer, voltage drop is greater, and distribution losses are larger than on a system having a high power factor. The installation of synchronous motors, to obtain a reasonably good power factor, will eliminate these troubles. These have been used in several installations with excellent results. They are designed to drive mechanical loads up to their capacities in K.V.A. when operating at 100 per cent. power factor, when they will exert a considerable corrective effect. They are of the self-starting type, secured by providing the field poles with a squirrel cage winding similar to rotor winding on induction motors. These machines are most efficient when directly connected to motor generator sets, air compressors (where same can be started with by-pass open to atmosphere), or centrifugal pumps starting with discharge valve closed, or any machinery not requiring more than 25 to 40 per cent. full load starting torque. Where considerable power is purchased from a central station, a penalty clause is almost always in the contract against power factors below 75 per cent.

Care and oiling of motors.—More motors are destroyed from an over supply than a lack of oil. When a motor bearing becomes short of oil, the only thing that happens is that the shaft and bearing freeze, the overload relays operate, and the motor stops. After babbiting bearing and cleaning shaft, the motor is ready for service again. On the other hand, when too much oil is poured into the bearings, it is drawn into the windings and results in insulation breakdown and total destruction of the windings. To eliminate some of these troubles, motors should be located in clean, dry, and accessible places, with ample light for inspection.

Installations.—With open wiring installations, the possibility of trouble and delays is greater than in installations in approved conduit and fittings. While the initial cost of a conduit installation is greater, the maintenance cost more than offsets the initial cost, and, incidentally, a much better looking installation is obtained. For pipe installations, Sheraduct conduit should be used. It is not good practice to use ordinary galvanized iron pipe, as there is no guarantee that this material is free from scale and obstructions on the inside, which are liable to injure the insulation of cables while being installed. It is also extremely hard to form the numerous bends necessary in conduit installations with this material. When lines have to be run in damp or wet locations, lead-covered cable with approved potheads should be used. While the cost of this material is high, it is good insurance. Care should be exercised in making joints and splicing cable. All wires should be cleaned, and after the splice is made, it should be soldered, making a good mechanical and electrical connection, covering with rubber and okonite tape, the number of layers depending on the potential of the feeders. Spliced cables or wires should never be enclosed in conduit pipes.

Transformers.—There are numerous installations where two tranformers operate open delta on a 3-phase system, in which the full load output is only 86 per cent. of the transformer rating. The initial cost is somewhat less than with a 3-transformer installation. With the 2 transformers, should one unit give out, the factory would have to be closed down until another transformer is secured, or the damaged one repaired. With 3 transformers, one can very easily be removed from the line and the factory still operate under reduced load until another is secured or the damaged one repaired.

General.—The circuits from a power plant should be run in approved conduits to some centrally located point and distributed through fused safety switches in conduit to the various starters throughout the factory; all safety switches to be properly fused. These fuses are for feeder protection only, the overload relays taking care of the motors.

The following suggestions are made regarding installations: All motors over 5 h.p. should be equipped with magnetic starters, overload relays no voltage release and time limit acceleration. Install all motor safety feeder switches and magnetic control panels in stations located as near load centres as possible. Install circuits from power plant to station buss bars in conduit and into safety switches. All the control panels being located in one room, it is a comparatively simple matter to connect from safety switches into the magnetic control panels. From the various central panels, the motor feeders should be run in conduit to the motors. The start and stop push button stations require very little space and can be located in almost any place in the factory convenient to the operators. Having the magnetic starters all located in one station has several advantages. The whole installation can be supervised by one man; the apparatus can be kept clean and free from moisture; the hazard of electric shocks is practically eliminated; the possibility of unauthorized persons changing overload setting is entirely avoided.

Magnetic starters are used very successfully for remote control of squirrel cage or wound rotor, reversing or non-reversing motors. With the control for squirrel cage motors, auto-transformers with several taps for reduced voltage starting are used with magnetic contractors for switching from start to run positions. Time limit acceleration is positive 15 to 25 secs., according to motor service being allowed for motor to reach synchronous speed before switching from the start to run positions. With the magnetic starter, the possibility of the motors being thrown across the line before momentum has been gathered, resulting in blown feeder fuses, burnt contacts, possible danger to motors, belts, driven machinery, and high initial rush of current at power plant, is eliminated, and, incidentally, loss of production from careless or ignorant operation avoided. Also, it is impossible for the operator to keep starter in running position until starting coils are damaged.

Magnetic starters for wound rotor motors, reversing or non-reversing, are furnished with 4 or 5 points resistance forward or reverse, grid type resistance being used. These starters have the same protective features as above. With the reversing type, it is impossible to throw the motor from full ahead to full reverse, when the operator throws the master controller from full forward to full reverse, commonly termed "plugging" in crane service. The only thing that can happen is that the contactor on first point of resistance only closes and remains in this position until the high rush of current subsides when second point becomes operative, the motor stopping and reversing in reasonable time, no damage being inflicted on motors, driven machinery, or power plant. This control is excellent for overhead crane, runway table, or any severe reversing service.

Motor-driven Centrifugal Pump Installations.—Pumping stations usually being located some distance from factory or power plant, a transmission line is necessary. The potential of the line being governed by its distance and load, however, step-down transformers for lighting and power are almost always necessary. The operating voltage would be governed entirely by conditions at the pumping plant. In large plants, the squirrel cage motors are objectionable on account of the large starting current taken from the line. The wound rotor motor should then be considered. In many installations, water is taken off at a much greater or less head than the equipment is designed for. This is a double error, and where at all possible should be avoided. Taking water off at increased heads decreases the output, the motor not running at full load, which lowers the power factor. On the other hand, with heads decreased to any extent, while the output is increased, the efficiency of the apparatus is lowered, and the power cost increased. Should the motor not be designed to take care of this condition, there is danger of its being overloaded and damaged.

The wiring of pumping plants should be along the same general lines as the factory. Each starter, however, should be furnished with integrating watthour meters. In this manner, it is possible to determine the distribution of power over the system. For domestic supply pumps with elevated tanks, magnetic control with float switch makes an excellent arrangement; when the water reaches the low level the motor starts automatically, stopping at the high level. In installations of this kind, overload relays and low voltage release for protecting the motors should be furnished; also a check or preferably a double check valve should be inserted in the discharge line. With installations of this kind, a continuous water supply is assured, water wastage from overflowing tanks eliminated, power costs and maintenance costs reduced. All the maintenance necessary is a few minutes of one man's time about once or twice a week to clean and oil the apparatus.

Lighting of Factory and Pumping Plants.—Too much thought and study cannot be given to this problem. Good lighting, correctly distributed, with shades, reflectors and modern gas-filled lamps, actually reduce current. The lighting cannot be too good. Plenty of light and better lighting result in better and more work, more satisfied organization and fewer accidents. Three-wire 220-110 volt feeders should be run in conduit from transformers into fused steel distributing boxes, conveniently placed throughout the factory. The number of circuits per panel would be determined by conditions. The feeders should be fused and distribute 2-wire 110-volts, care being taken to balance as near as possible the 3-wire system. Each circuit should be arranged to carry not more than 550 watts. Almost all factories require some lighting during daylight hours. These circuits should be arranged independently of night circuits, to eliminate unnecessary burning of lamps during daylight hours, increasing life hours of lamps, and saving in current.

Transmission Systems.—Transmission lines vary with conditions; length of line, load, and potential desired must be considered. In laying out transmission lines on plantations, it is good practice to keep the line, if at all possible, out of cane fields. While burning off cane, the lines, hardware and insulators are often damaged. When the lines must pass through cane fields, consideration should be given to Bates steel poles, which are inexpensive, easy to erect and eliminate the possibility of total line destruction in the event of accidental fire with no prepared firebreak. The only objection to the steel pole is the fact that in Hawaii it is found very necessary to wire brush and paint them at least once each year to prevent rusting. For general transmission purposes, butt-treated cedar poles are favoured. Trouble has been experienced with burned cross arms and pole tops, where lines were running close to the sea. This trouble was successfully overcome by bonding.

In erecting transmission lines, a good mechanical job should be insisted upon, care being given to depth of holes, and proper tamping of poles. Angle poles should be securely guyed. Where transformers are installed, some approved fused cut-out should be inserted in the primary lines. The secondary from lighting transformers should be run 3-wire 220-110 volts with the neutral grounded at both ends.

Transmission lines should be provided with some suitable air switch so that the line can be disconnected from the system for making repairs, or in case of line trouble. They should be provided with approved type lightning arresters. The cost is small against the protection afforded.

Plantation camp street lighting.—Where camps are located close to mill or power plant, series lighting controlled from the plant is the best arrangement. Where camps are widely scattered, the cost of the series system would be prohibitive. As an alternative to the series arrangement in outlying camps, where more than one lighting transformer is installed, a cheap multiple installation can be made by tying the third or neutral wire of all transformers together, necessitating the running of one only additional wire. This arrangement with time clocks gives good service. With only one transformer available, the time clock is the only solution. The clock can be set for operation on or off at any time desired, eliminating the possibility of light burning during daylight hours.

Plantation camp metering.—It is advisable to meter all camps in preference to establishing a flat rate system. It will be found that the power consumption with a metered system is very much less than with a flat rate system, because the user will be much more careful in his use of the current if he finds that careless usage increases his power bill.

Imports of Sugar and Sugar Machinery into India, 1924-25.

Dept. of Overseas Trade Report.)

In a Report on the Conditions and Prospects of British Trade in India for the year 1924-25, H. M. Senior Trade Commissioner in India and Ceylon gives the following figures of the value of the imports of sugar machinery into India:—

Countries of Consignment.	1922-23 Rs. (lakhs).	1923-24. Rs. (lakhs).	1924-25. Rs. (lakhs).
United Kingdom	11	12	16
Belgium	5	less than 1 lakh	less than 1 lakh
Other countries	1	1	1
Total	17	13	17

Under the heading "other countries" in 1923-24 were included trifling quantities from the United States of America, Belgium and Germany, amounting in all to only half a lakh.[1] The Empire Engineering Works, Cawnpore, continues to produce a certain amount of sugar machinery, but Glasgow makers supply the bulk of India's requirements of new plant.

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[1] 1 lakh = 100,000 rupees or £7500, reckoning the rupee at 1s. 6d.

Sugar.—The imports of sugar ranked second in the total import trade of India in 1924-25, the total value being exceeded only by cotton manufacturers. The subjoined table shows the imports of 16 Dutch standard and above (excluding beet):—

Countries of Consignment.	1923-24. Rs. (lakhs).		1924-25. Rs. (lakhs).
Belgium	6	....	14
France	2	....	3
Ceylon	2	....	4
Straits Settlements (including Labuan)	12	....	11
Java	13.06	....	14.93
China (including Hong Kong)	23	....	11
Japan	*	....	*
Egypt	3	....	1
Mauritius and dependencies	6	....	3.64
United States	*	....	*
Other countries	3	....	1
Total imports	13.63 †	....	19.02

The principal ports of entry in order of importance were Calcutta, Karachi, Bombay, Madras and Rangoon.

A marked feature of the past three years has been the growth of the trade with the Continent in beet sugar. The figures are:—

Principal Countries of Consignment.	1923-24. Rs (lakhs).		1924-25. Rs. (lakhs).
United Kingdom	*	....	*
Germany	19	....	61
Netherlands	1	....	*
Belgium	3	....	8
Austria	28	....	8
Hungary	41	....	31
Czecho Slovakia	19	....	16
Other countries	2	....	8
Total	1.13	....	1.32

In the year under review, the United Kingdom shipped 19 tons valued at Rs. 5284, but now that beet sugar growing is being developed in East Anglia, it is hoped that we shall see a steady increase in the British share.

The following table gives the other types of sugar imported:—

Description.	1923-24. Rs. (lakhs).		1924-25. Rs. (lakhs)
Sugar, 15 Dutch standard and below	1	....	2
Molasses	45	....	30
Confectionery	21	....	23
Saccharine	1	....	*

The imports of molasses are all drawn from Java. Confectionery, however, is an important British export. In 1923-24, of a total of 21 lakhs, the United Kingdom shipped 17 lakhs or 81 per cent., Switzerland contributed 5 per cent., Japan 4 per cent., and Holland, France, and Italy smaller shares. British exporters appear to be maintaining their position in this trade.

According to the Ministry of Agriculture a preliminary estimate of the area already under contract for the growth of sugar beet in Great Britain in 1926 is 128,500 acres, as compared with the final total of 56,200 acres in 1925 and 22,600 acres in 1924.

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* Less than 1 lakh.

† I.e., 13 crores, 63 lakhs, equal to 136,300,000 rupees, or say £10,222,500.

The Sugar Trade in India during the Official Year, 1924-25[1].

By WYNNE SAYER. Esq., B.A.,
Secretary, Sugar Bureau.

So far as India is concerned, all factors during the year 1924-25 (April-March) were favourable for heavy importation of sugar from foreign countries, viz.: (1) There was a substantial reduction in the production of raw sugar or gur in India during the season 1924-25; (2) the general trend of the market for lower prices furnished an opportunity to replenish the low stocks, both visible and invisible, carried in previous years as the result of higher prices then prevailing: and (3) the normal increase in consumption which was nearly 15 per cent. before the war had only been checked in the interval by high prices and was expected to make itself felt again as soon as the prices dropped to a reasonable figure.

RAW SUGAR.

Gur Production.—India's net production of cane and palm gur (raw sugar) during the season April to March, 1923-24 (i.e., excluding cane used for chewing and planting purposes), the major part of which became available for consumption in the earlier part of the year 1924-25, amounted to 3,103,000 tons against 2,953,000 tons in the previous year, while the quantity of cane gur and palm jaggery produced in the season 1924-25, the greater part of which would be available for consumption and refining during the year 1925-26, amounted only to 2,400,000 tons. Thus in 1923-24 there was an increased production of gur by 150,000 tons over the previous year, but the prospects of an unsatisfactory crop during the next year sent the prices for gur up during the latter half of the year under review and gave an impetus to heavier importation of refined sugar.

Gur Exports.—As usual, a small quantity of this commodity was exported to the United Kingdom, Ceylon and other neighbouring countries, especially from the Madras Presidency, amounting to 20,000 tons as compared with 36,325 tons last year. The decrease was mainly due to the United Kingdom taking only 17,585 tons as against 31,872 tons in 1923-24.

REFINED SUGAR.

Home Production.— The year 1923-24 was very favourable for the factories and refineries working in India. As a result of the larger acreage under cane and favourable weather conditions, factories did not find it difficult to obtain supplies of cane, and the increased production of gur enabled refineries to work to their full capacity. Almost all the factories worked during the season, and the production of refined sugar in India increased from 74,050 tons in 1922-23 to 94,796 tons in 1923-24. Adding the sugar made by native processes (estimated at some 50,000 tons) we arrive at a total production of 144,800 tons of refined sugar in India against 124,000 tons last year.

Imports.—India's own production of refined sugar is quite insignificant as measured by her requirements. She has therefore to import large quantities from abroad, the main sources of supply being Java, countries on the continent of Europe, and Mauritius. Java, including the Straits Settlements (which are only forwarding agents for Java sugar), remained the principal source of supply and contributed 72 per cent. of the total imports during 1924-25. Though there was a net increase in the quantity imported from Java, the imports being 483,100 and 371,200 tons in 1924-25 and 1923-24, respectively, the percentage of imports from Java to total imports was lower than in 1923-24 when it amounted to 90 per cent.

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[1] Reproduced (much abridged) from the *Indian Trade Journal*, December 17, 1925.

The imports from Mauritius were the largest on record after the pre-war year 1913-14, amounting to 20 per cent. of the total as compared with hardly half a per cent. last year. Mauritius sugar was mainly imported into Bombay and Sind, the quantity amounting to 95,200 tons and 27,700 tons in these provinces or 72 per cent. and 21 per cent. respectively, out of the total imports of 133,000 tons of this sugar during the year. The balance was chiefly taken by Bengal. These heavy imports into India were caused by a reduction in the import duty from 25s. 8d. to 11s. 8d. per cwt. of sugar carried out by the Labour Ministry in England, which made the preference enjoyed by the Empire-grown sugar less effective (by bringing it down from 4s. 3d. to 1s. 11d.), though the old rate of Imperial preference was maintained at one-sixth of the import duty. Recently, Mr. Baldwin's Ministry has restored the amount of preference previously enjoyed by Empire sugar, and Mauritius sugars will be attracted in future to the United Kingdom again.

The other large source of supplies was beet sugar, mainly from Austria-Hungary, Czecho-Slovakia and Germany. The imports increased from 29,700 tons in 1923-24 to 45,900 tons during the year under review. Germany supplied this year 21,700 tons against 5100 tons last year, Hungary 10,800 tons against 11,300 tons, Czecho-Slovakia 5000 tons against 5200 tons, Belgium 3000 tons against 800 tons, and Austria 2600 tons against 6500 tons last year. With the rapid recovery of the beet sugar industry in Europe, India's sole dependence on Java has been considerably modified.

Re-exports.—The re-exports showed a fall from 35,801 tons in 1923-24 to 21,990 tons in 1924-25. The United Kingdom took large quantities in the preceding two years but almost disappeared from the market in the year under review with only 50 tons, as compared with 6150 tons and 15,700 tons in 1923-24 and 1922-23, respectively. Arabia and Persia took 5300 tons each, Mesopotamia 3600 tons, Kenya Colony and Zanzibar and Pemba, 3100 tons and the Bahrein Islands 2300 tons.

Consumption.—In all there were 709,141 tons white and brown sugar available in India for consumption during the year, an increase of roughly 180,000 tons in one year. This increase compares favourably with the increase of barely 100,000 tons in the United Kingdom and 75,000 tons in the United States of America.

MOLASSES.

During the year under review, India's imports of molasses fell from 63,672 tons in 1923-24 to 57,029 tons. The production of this commodity in India during the season 1923-24 amounted to 120,000 tons. Most of these imported and locally produced molasses are consumed within the country, especially for curing tobacco and for the manufacture of rum. In this connexion, it may be mentioned here that the question of manufacturing power alcohol from molasses has now been actively taken up by the United States of America, the United Kingdom and other countries of the world, and a good demand has been created for this commodity. Large quantities from Java have been contracted for shipment to the United Kingdom, and India may find it difficult in future to obtain necessary supplies of molasses from Java at the price paid by her so far.

FUTURE PROSPECTS.

The year 1925-26, barring any untoward event or unfavourable weather conditions, is likely to produce a three-quarter million ton increase over the sugar year just ended, and it will be a difficult question for the producing countries to find markets for their produce at anything like remunerative rates. It may happen that some of the cane growing countries when they find that the price has fallen below the cost of production may restrict their crop and so bring about an adjustment between production and consumption at a price which leaves the ordinary rate of profits to the industry. But this is not possible at short notice, and till then we should be prepared for an era of low prices and severe competition. In this struggle Indian factories would have little or no chance of surviving, had not two factors in their favour started to operate at the critical moment. The first is the conversion of the *ad valorem* duty on sugar into a specific duty of Rs. 4-8-0 per cwt. for 23 D. S. and above. The industry now knows definitely where it stands and can push on with the work of ensuring adequate supplies and bringing about technical improvements both in the milling plant and in the boiling house. The other is the complete demonstration of the superiority of new cross-bred varieties of cane from Coimbatore. The writer realized the great value of these canes early in 1920 and took steps to multiply them, put them through the mill with a view to find out how they behaved in the factory, and, when satisfied of their superiority over local canes both from the growers as well as from the factory point of view, distributed large quantities of seed-cane over the white sugar tract in Northern India, so that this year there are over 5000 acres under these canes in the very tract in which sugar factories work, and it is confidently believed that over 20,000 acres will be under these canes next year. The white sugar tract has roughly the same area under cane annually as the total cane area in Java. It is here that the factories are concentrated, and it is here that the cane which is grown by cultivators is the most worthless from the tonnage point of view. It is therefore here that every possible effort should be made jointly by the industry and the Agricultural and Co-operative Departments to replace the inferior local cane and to introduce improved methods of cane cultivation and manuring, if any reduction in India's imports of white sugar is to be effected. The writer is fully convinced that the costs of cane production in this part can allow a margin to any country, and if the factories assist in distributing improved seed cane to those growers who supply cane to the factory and also arrange to give them on loan supplies of oil-cake or ammonium sulphate, the cost being recovered at the time of making payments for cane sent to the mill, a real transformation in the present state of the Indian sugar industry will take place, and that too at no distant date. The ground has already been prepared, and the confidence of both large scale growers as well as small ryots has been obtained, the best and most economical methods for cane cultivation suited to this tract have been evolved and tested, and the growers are adopting them. A sound and efficient organization is required to be set on foot to spread these improvements and, as has been said before, the Agricultural and Co-operative Departments as well as the sugar industry should take the matter up. Imports of sugar at present spell revenue, and India has got to forego that revenue in her own interests and realize that she pays at present far more than she receives. It is no use decrying the increasingly heavy imports or talking of the drain on India when we are not putting forth any real efforts to stem the rising tide. A clear lead has been given, and India must make her effort now, or else "too late" will again be written on the wall and the regeneration of her industry will prove impossible.

Commenting on the decision of the Japanese Government to buy only British rails in future, the *Japan Weekly Chronicle* says :—"Since 1913 Japanese railway officials have been taking stock of the wearing properties of rails purchased from Britain, America, France, Germany, Belgium and Russia, as well as of those made in Japan. The investigations have been completed and a report of 1000 pages is to be published soon. American rails have been found to be the worst in the world, followed by those turned out by Japan. The British make has proved the most suitable for the country.

Basic Dyes as Flocculating Agents for Approximate Quantitative Determination of Colloids in Sugar-House Liquors.

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(*Continued from page 28*).

INFLUENCE OF THE HYDROGEN-ION CONCENTRATION ON FLOCCULATION.

The data from an experiment in which the quantity of dye was kept constant and the *pH* was varied are shown in Table 4. The electric neutrality point was first determined for a solution of raw cane sugar No. 1, and a series of tubes was arranged so that each tube contained the isoelectric proportion of dye and raw sugar solids. Then to each tube an increasing quantity of either acid (dilute HCl) or alkali (dilute NaOH) was added so as to vary progressively the hydrogen-ion concentration. When acid is added to a mixture of dye and raw sugar solids which are present in isoelectric proportion, the colloidal particles present become positively charged; when alkali is added they become negatively charged. For solutions of this sugar with *pH* values less than 6·10 less standard dye solution would be required to electrically neutralize the colloidal particles and for solutions with *pH* values greater than 6·10 more dye solution would be needed to produce exact neutralization than is required at *pH* 6·10, the isoelectric point under the original conditions of the test. In order that dye-flocculation tests may be made on a comparable basis it is necessary that all solutions in the series of tubes be adjusted to the same *pH* value. This experiment also shows the two limits of hydrogen-ion concentration at which complete flocculation may occur under the conditions mentioned.

Table 4.—Influence of the hydrogen-ion concentration on flocculation.

500 mgrms. of solids (raw cane sugar No. 1); total volume, 100 c.c.

Milligrams of Dye.	Migration Velocity of Colloidal Particles μ/sec./volt/cm.	*pH*.	Remarks.
2·1	+ 0·59	4·78	Flocs did not settle; upper limit of flocculation.
2·1	+ 0·48	4·98	Good flocculation.
2·1	+ 0·37	5·31	,, ,,
2·1	+ 0·22	5·73	,, ,,
2·1	0·00	6·10	Isoelectric point.
2·1	— 0·14	6·35	Good flocculation.
2·1	— 0·72	6·77	,, ,,
2·1	— 1·37	7·22	Lower limit of flocculation.
2·1	— 1·57	9·54	No flocculation.
2·1	— 1·57	9·55	,, ,,

STANDARDIZATION OF THE *pH* OF SAMPLES EXAMINED BY THE DYE METHOD.

It is apparent from the data of Table 4 that the results obtained by the dye test are on a much more comparable basis when the *pH* values of all samples examined are identical. This standardization of *pH* can be easily accomplished by testing the sample with an indicator on a spot-plate. Two burettes can be kept at hand, one containing a very dilute solution of hydrochloric acid (about 0·005*N*) and the other sodium hydroxide solution (about 0·005*N*). Before proceeding with the dye test either acid or alkali is added to the sample, and a few drops are tested on a spot-plate with methyl red until the last trace of red colour disappears, giving a light yellow colour. The *pH* of the solution will then be sufficiently close to 6·0. This *pH* value represents a satisfactory point in the flocculation range of all samples which we have so far examined.

Standard *pH* values as high as 8·0 and above should be avoided in view of the possibility of changes in the basicity of the dye. Low *pH* values should likewise be avoided. With very dark sugar liquors the spot-plate method is not very sensitive, and it should be checked by the block comparator method (Barnett-Gillespie). In most cases the sugar liquors will have been considerably diluted for the dye test, and the colour of the solution will not interfere with the colorimetric *pH* determination.

FLOCCULATION OF BENTONITE.

Bentonite, a non-refractory clay, has properties,[1] such as the power to adsorb dyes and colloids, which are characteristic in many respects of colloidal gels. The use of bentonite in clarifying cane juice has been suggested. When observed in water suspension in a cataphoresis apparatus it is found to possess an electro-negative charge. Since the colloids in sugar liquors are also usually electro-negative, it is evident that bentonite will not produce clarification by electrical neutralization of these colloids under ordinary conditions.

When a basic dye, such as night blue, is added to a water-suspension of bentonite the speed of the colloidal particles in a cataphoresis apparatus decreases with increasing quantities of dye until the particles lose all their original electric charge, after which they acquire a positive charge from the excess dye. Flocculation occurs while the particles still possess a negative charge and also when the neutral point is passed and the particles become positively charged. Without the aid of a cataphoresis observation it is impossible to determine when the particles of bentonite are electrically neutralized. If a series of tubes containing dye and a suspension of bentonite in water is arranged so that the neutral point is at about the middle of the series of tubes covering the flocculation range and the contents of each tube is filtered separately, each filtrate will be devoid of dye colour, showing that any excess of dye is completely adsorbed by the flocs. The results of tests on the flocculation of bentonite by night blue are given in Table 5.

Table 5.—Flocculation of bentonite.

10 mgrms. of solids; total volume, 50 c.c.

Milligrams of Dye.	Order of Magnitude of Flocculation.	Migration Velocity of Colloidal Particles µ/sec./volt/cm.	*pH* at Isoelectric Point.
2·5	X	−3·3	—
3·0	XX	−3·0	—
3·5	XXX	−2·7	—
4·0	XXXXX	−1·0	—
4·5	XXXXX	0·0	5·80
5·0	XXXXX	+2·0	—

$$\text{Isoelectric ratio } \frac{4\cdot5}{10} = 0\cdot45$$

COMPARISON OF RESULTS OBTAINED BY THE DYE TEST AND BY ULTRA-FILTRATION.

Table 6 gives the results of dye and ultra-filtration tests on cane juice subjected to different clarification treatments.

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[1] ALEXANDER, *Ind. Eng. Chem.*, 1924, 16, 1140; WHERRY, *Amer. Mineralogist*, 1925, 10, 120.

Comparison of the isoelectric ratios with the percentages of colloids (Table 6) separated by ultra-filtration (standard collodion membranes used) shows that the two series of values varied in a generally parallel manner, but not in the same proportion. The values in the last column of Table 6 show that the ratio of the isoelectric ratio to the percentage of colloids separated by ultra-filtration increased after the last two clarifications, which were much more effective in removing colloids than the first two clarifications. Although a small proportion of colloidal material passed through the ultra-filters (shown by testing the filtrates with night blue), the increase in the ratio just mentioned is very probably due to the variation in magnitude of the electric charge of the different types of colloids present and the selective action of the clarifying agents in removing them. The influence of this variation on the validity of the dye test is discussed later in this article.

Table 6.—Colloids in cane juice after different types of clarification.

Treatment of the Juice *	Isoelectric Ratio mgrms Dye / mgs Juice Solids	pH at Isoelectric Point	Total Weight of Colloids by Ultra-Filtration Grms	Total Weight of Solids Ultra-Filtered Grms.	Colloids (dried) in Total Weight of Solids Ultra-Filtered. Per cent.	Ratio between Isoelectric Ratio and Percentage of Colloids by Ultra-Filtration.
(1) Juice + 2 per cent. Infusorial Earth	0·00589	5·97	0 8187	349·20	0·234	0·0252
(2) Juice + 2 per cent. Infusorial Earth + ½ per cent. Carbon	0·00568	5·97	0·7148	352·20	0 203	0·0280
(3) Juice + 2 per cent. Infusorial Earth + 2 per cent. Hydrous Aluminium Silicate	0 00520	5·97	0·2944	346·00	0·085	0·0612
(4) Juice + 2 per cent. Infusorial Earth + 2 per cent. Carbon	0 00451	5·97	0·2553	354·44	0·072	0·0626

Table 6 shows that 2 per cent. hydrous aluminium silicate removed almost as much colloidal material as 2 per cent. carbon. The colour of the juice treated with the carbon, however, was decidedly lighter than that of the juice treated with the hydrous aluminium silicate, thus illustrating the specific adsorptive action of carbon towards certain types of pigments. This comparison also proves that a colorimetric measurement is not an adequate test for determining the relative effects of clarifying agents in eliminating colloids.

Table 6 suggests an interesting comparison between the dye test and ultra-filtration as methods for the approximate quantitative determination of colloidal material. The dye test is more sensitive, but under some conditions it is less accurate than standardized ultra-filtration. The dye test is of great value for checking the permeability of ultra-filters to colloids. The data furnished by the dye test have only comparative value, unless a calibration is made by reference to data furnished by ultra-filtration or some other method which gives direct colloid values. Ultra-filtration may require several days, but the dye test, including ultra-microscopic observation, may be completed in 10 mins.

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* Percentages of clarifying agents are based on the solids content of the juice.

SUMMARY OF EXPERIMENTAL RESULTS.

A comparison of the results in Tables 1, 2, and 3 indicates that the beet molasses sample contained about 10 times as much colloidal material as the raw sugar samples. Tables 2 and 3 present an interesting comparison of the quantities of colloidal material in two typical raw cane sugar samples. The poor-filtering raw sugar (sample 1) contained about twice as much colloidal material as sample 2, which gave a melt that filtered normally. Ultra-filtration tests on solutions of these two sugars, as well as small-scale rate-of-filtration tests, agreed in indicating that sample 1 contained decidedly more colloidal material than sample 2. The results of all three tests were in agreement with observations in the refinery on comparative rates of filtration of the raw sugar melts.

It is necessary to control the hydrogen-ion concentration in order that flocculation tests may be made on a comparable basis. Table 4 demonstrates this point clearly and also shows the extreme *pH* limits for flocculation with night blue. The data in Table 5 show that the behaviour of bentonite towards night blue is in general the same as that of the colloids in sugar-house liquors and sugar.

Table 6 gives a comparison between the quantities of colloids actually separated by ultra-filtration and the comparative quantities indicated to be present by dye flocculation in cane juice which had been clarified by several methods.

MISCELLANEOUS OBSERVATIONS ON THE DYE METHOD.

Basic dyes may be used, with certain possible limitations to check the efficiency of collodion membranes or other ultra-filters for the purpose of determining whether or not they are permeable to colloids. By ultra-filtering a standard colloidal suspension and examining the filtrate with a dye solution, the quantity of dye required for complete flocculation will be an approximate index of the permeability of the ultra-filters to colloids.

Caramel prepared from sucrose showed a weak negative charge in the cataphoresis apparatus. When the caramel dispersion was electrically neutralized by night blue little tendency to flocculate was manifested and no flocs were visible, even after the solution had stood for several days. This slight tendency toward flocculation when electrically neutralized is also shown by the water-reversible fraction[1] of the colloids separated from various sugar-house liquors by ultra-filtration. This, together with other observations (which will be included in a future publication from this laboratory), indicates the existence of a large proportion of "caramelization products" in the water-reversible colloids of sugar-house liquors, particularly in after-products like molasses.

When an aqueous suspension of a reversible colloid is evaporated to dryness and the colloid is again dispersed in water, its electric charge may decrease progressively, as shown by the following tabulation :—

		Isoelectric ratio.
A.	Aqueous suspension of water-reversible colloid from molasses.. ..	0·1285
B.	Suspension A, after drying and again dispersing in water	0·1184
C.	„ B „ „ „ „	0·1111
D.	„ C „ „ „ „	0·0963

The cause of this progressive decrease is not known, but it may possibly be due to a "denaturing" effect, which changes the specific ion-adsorbing property of the colloid. The change may possibly be similar to the "aging" of colloids.

A preliminary study of the effect of electrolytes on the dye flocculation has been made. It was noted that anions of high valency cause a displacement of the isoelectric point, so that more dye is required for neutralization, while di- and trivalent cations cause an opposite displacement of the isoelectric point, so that less dye is needed for neutralization.[1]

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[1] PAINE, BADOLLET and KEANE, *Ind. Eng. Chem.*, 1924, 16, 1252

Several experiments were performed with raw sugar to determine the effect of sucrose concentration on the migration velocity of the colloidal particles at a constant hydrogen-ion concentration. The total solids content in a volume of 100 c.c. was increased from 500 to 13,000 mgrms. by adding a solution of carefully purified sucrose free from colloidal contamination. An excellent flocculation was observed at each sucrose concentration, and the change in velocity of the particles was very small, showing that the sucrose content had little influence on the flocculation.

After the investigation described in this article was completed an article by ROHLAND and MEYSAHN[2] came to our attention. In their method aniline blue was used to determine the quantity of colloids in waste waters. After the liquid was filtered from the flocculated dye aggregate "the excess of dye over that required to produce flocculation" was determined colorimetrically in the filtrate. This quantity of dye subtracted from that originally added was assumed to give the quantity required to cause flocculation.

Without the use of a cataphoresis apparatus it is impossible to determine when maximum flocculation occurs, i.e., when the colloidal particles are exactly neutralized. The method employed by ROHLAND and MEYSAHN, therefore, is subject to considerable error. Filtering off the dye precipitate and determining colorimetrically the quantity of dye in the filtrate gives a result in excess of the quantity of dye required to electrically neutralize the colloids.

A sample of cane juice was subjected to the dye test described in this paper and also to the test described by ROHLAND and MEYSAHN. Our test required 12 mgrms. of dye to neutralize exactly the colloidal particles; the other required 18 mgrms. of dye before any colour was observed in the filtrate. When the two tests were repeated it was impossible to duplicate closely the 18 mgrms. result, whereas the 12 mgrms. result was checked within 0·3 mgrm. on two occasions. Asbestos and paper filters used in filtering and likewise the flocculated dye aggregate may adsorb some excess dye, thus causing high results in the Rohland and Meysahn procedure. Furthermore, aniline blue is very seldom pure and in most cases two lots vary so greatly that it is difficult to obtain comparable results. Another objection to aniline blue is the fact that, as usually manufactured, it is acidic and presumably negatively charged in aqueous suspension, although in some cases it has been observed to be basic. While night blue is more expensive, its composition is fairly constant and no difficulty is experienced in obtaining closely agreeing results with different lots of this dye.

The night blue test is especially sensitive with negatively-charged colloids of typical suspensoid type, such as sulphide sols (arsenic tri-sulphide, etc.), and produces flocs which quickly aggregate and settle to the bottom of the container.

THEORY OF THE DYE TEST AND ITS LIMITATIONS.

In order that the dye test may give data of the highest precision, it is necessary that all colloidal particles (or, more specifically, equal weights of colloids) shall possess the same magnitude of electric charge of the same sign.

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[1] The effect of electrolytes on the behaviour of colloids in sugar-house liquors is similar in a number of respects to the effect of electrolytes on colloidal clays, as has been observed by MATTSON (unpublished paper).

[2] "Method for determining colloids in waste-water containing sugar," *Zeitschr. Ver. deut. Zuckerind.*, 1913, 63, 167.

This is not true, however, in the case of sugar-house liquors, as the colloidal material consists of different chemical compounds which vary in the specific properties that determine the electric charge. In addition, the magnitude of the charge may be changed by adsorption of ions from solution, so that the character and quantity of the electrolytes present may affect the electric charge and therefore the quantity of dye required to neutralize it. Under ordinary conditions the nature of the ions present is not of such a nature as to cause the colloids to become positively charged. On the other hand, the influence of the electrolytes is rendered uniform, so far as the hydrogen-ion concentration is concerned, by adjusting all samples to the same *pH* value. However, the influence of variations in the nature or concentration of other ions which may only slightly affect the concentration of the hydrogen-ion is not known and must at least be regarded as a possible source of error in the dye method.

Although the magnitude of the electric charge of the colloids of sugar-house liquors may vary according to the specific properties of the colloids and the nature and quantity of electrolytes present, our experiments indicate that the electric charge of night blue is relatively constant. Different samples of the dye gave practically the same isoelectric ratio with the same colloid sample. It seems probable that the electric charge of night blue is largely if not entirely due to electrolytic dissociation and the production of a large cation with accompanying colloidal aggregation (similar to that ascribed to mastic[1]). At any rate, the electric charge of night blue appears to be relatively constant—an important consideration from the standpoint of the dye test here described.

While the dye test gives only comparative values, it is possible by ultra-filtration to establish factors by which they can be converted into direct colloid values. It is quite probable that such a factor will be relatively constant for any given sugar-factory liquor. From a factory-control standpoint, however, it seems probable that comparative values will be adequate for most purposes, as the principal consideration is to detect deviations from the normal.

For the purpose of estimating the validity of the dye test and its probable limitations, two principal cases may be considered. (1) Comparison of the colloid content of the same factory liquor (or sugar) from time to time; (2) comparison of the colloid contents of different types of liquors (or sugar). In case (1) the variation in *average* magnitude of electric charge of the colloids present will be small and the dye method will attain its greatest degree of accuracy. In case (2) care must be used in interpreting results, as the types of colloids and the average magnitude of electric charge may vary considerably in the liquors compared; in this case it is advisable by means of ultra-filtration to establish factors for calculation of direct values.

The close agreement between the ratios in the last column of Table 6, when comparing clarification 1 with 2 and 3 with 4, illustrates case (1). In the juices compared the types of colloids and average magnitude of electric charge were very similar and the dye test gave values in close agreement with the ultra-filtration data. On the other hand, the dye-test values, without the use of a factor based on ultra-filtration, do not indicate the true relationship between the quantities of colloids present when clarification 1 or 2 is compared with clarification 3 or 4. In the juices which are now compared the types of colloids and the average magnitude of electric charge have been made to vary considerably through selective action of the clarifying agents.

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[1] Michaelis, "The Effects of Ions in Colloidal Systems," p. 32 *et seq.* (Williams and Wilkins Co., Baltimore, 1925.)

It is believed that most of the requirements of sugar factory and refinery control will be covered by case (1). The dye test can be advantageously used under case (1) in many ways, only a few of which will be mentioned: Comparison of colloids in any given beet sugar factory liquor when normal, immature and stored beets are used; comparison of colloids in the same cane sugar factory liquor when different varieties of cane, diseased cane, or cane milled at different periods after cutting are being ground; comparison in the sugar refinery of colloids in liquor passing into bonechar filters at different times, in liquor passing from bonechar filters from time to time, and in melts from different lots of raw sugar. We have no hesitancy in stating that the comparative values given by the dye test in these and similar instances of case (1) will be valid.

(*To be continued.*)

The "Sumasuco" Colorimetric Hydrogen-ion Testing Set.

(Specification of R. G. W. FARNELL, A.I.C., A.R.C.S.,
Chemist, Sugar Research Association, London.)

"ACTIVE" ACIDITY AND ALKALINITY.

During recent years a number of authorities have established the importance of the hydrogen-ion concentration in controlling the manufacture of cane or beet sugar, or the refining of raw sugar. They have shown that the method hitherto employed of determining the "acidity" and "alkalinity" by titrating with standard alkali or acid, does not give the *active acidity*, capable of causing inversion, or the *true alkalinity*, capable of inducing glucose decomposition.

According to the ionic or electrolytic dissociation theory, acids in solution in water dissociate into positive and negative ions. It is due to the positive or hydrogen-ion that the property known as acidity is due, the extent of the dissociation determining the "activity" or "strength" of the acid.

For example, although 10 c.c. of N/10 hydrochloric acid and 10 c.c. of N/10 acetic acid are both neutralized by 10 c.c. of N/10 sodium hydroxide, using phenolphthalein indicator, yet the inverting power of these two acids is widely different. Sulphuric acid, a "strong" mineral acid, is highly dissociated in solution; whereas acetic acid, a "weak" vegetable acid, is only slightly dissociated.

If equal weights of these two acids were heated under the same conditions with solutions of pure sucrose, the former would invert 60 times more rapidly than the latter. In the same way the mineral acids, sulphurous and phosphoric, are each considerably more "active" in inverting sucrose than the organic acids, as acetic, oxalic, malic, succinic, glycollic, etc., which occur naturally in raw cane juice.

Alkalinity is similarly explained. Bases in solution in water dissociate into positive and negative ions, but in this case it is to the negative or hydroxyl (OH) ion that the active alkalinity is due. A strong base, like sodium hydroxide, is highly dissociated in solution, contrary to weak ones, as ammonia, or to still weaker ones, as the plant bases (amines and betaines). Some salts also dissociate in solution to a greater or less extent.

IMPORTANCE OF H.I.C. IN PRACTICE.

Sugar juices, and syrups, refinery liquors, etc., depending on the stage of manufacture, may exist in varying degrees of dissociation, according to their content in "strong" or "weak" acids or bases. Not only inversion and glucose decomposition, however, depend on the H. I. C., but other important phenomena, such as the flocculation of the colloidal impurities in the clarification of both cane and beet juices and syrups.

Writing of cane juices, H. A. COOK states[1] that "it is a definitely established fact that there is a narrow margin of hydrogen-ion concentration at which the maximum results in clarification are obtained. We believe there is a definite hydrogen-ion concentration below which inversion may be detected in clarified juices. The inversion of sucrose in clarified juices begins at a much more alkaline reaction than has heretofore been realized." Settling qualities of tempered juice; rate of filtration of carbonated juice; colour removal by precipitates, as in carbonation and sulphitation, and by bonechar and decolorizing carbon; ease of massecuite boiling, growth of grain in pans and crystallizers, are all affected by their H.I.C., and probably considerably so.

METHODS OF DETERMINING H.I.C.

It is known that the electric potential of a hydrogen electrode immersed in a solution depends on the hydrogen-ion concentration of that solution. On this principle is founded the electrometric method of H. I. C. determination, which, however, is unsuitable (as at present developed) for the busy sugar-house laboratory, its operation requiring complicated apparatus and considerable time and experience.

More practical, more rapid, and more simple is the colorimetric method, which depends on the use of a series of indicators, each of which has a distinct range of colour between definite limits of hydrogen-ion concentration. In brief the procedure is to add some of the indicator (that selected depending on the product under examination), compare the colour produced with the series of shades given on the Clark colour chart, or better with the colours produced by a series of standard solutions of definite H I.C. concentration (called "buffers") to which indicators have been added, these forming definite colour standards.

In practice the H.I.C. is expressed according to the "*pH* scale," and an excellently clear account of the reasons for doing this is to be found in the paper contributed by BREWSTER and RAINES.[2] In our present short article it suffices to state that on this *pH* scale, the value 7·0 denotes true alkalinity. Numbers below this, as 6·0, indicate acidity; and above, as 8·0, alkalinity. Since these numbers are logarithms (the *pH* is the log of the reciprocal of the H.I.C.) *pH* 5·0 will denote an acidity 10 times greater than that of *pH* 6·0; and similarly *pH* 9·0 an alkalinity 10 times that of *pH* 8·0.

THE "SUMASUCO" COLORIMETRIC H.I.C. SET.

Recognizing the considerable importance in cane and beet sugar manufacture and refining of the H.I.C. in routine control, Mr. R. G. W. FARNELL, A.I.C., A.R.C.S., has designed for the Sugar Manufacturers' Supply Co., Ltd., London, a complete outfit for the purpose, intended to cover all likely conditions, suitable for cane and beet factories and for refineries alike, that is, an outfit universally applicable and arranged for the simplest and most convenient manipulation.[3] Mr. FARNELL, as Chemist to the Sugar Research Association, has carried out a good amount of useful work in hydrogen-ion concentration in factories in the West Indies, Natal and Mauritius.[4] He has now written clear and simple directions for making these determinations with this practical and inexpensive testing set. Apparatus and instructions are therefore now available at a reasonable cost to enable anyone to make, after very little practice, a test of the H.I.C. in the sugar factory or refinery in a few secor 's

According to returns published by the South African Customs and Excise Department, the 27 mills and two refineries established in Natal and Zululand purchased last year machinery and equipment to the amount of £180,683, of which £161,240 worth represented business with British firms, mainly those in Glasgow and Derby. Of the remainder £14,522 was accredited to the United States (including such firms as Fulton Iron Works, Petree & Dorr, and the Robbins Conveyor Co.), while Germany, Austria, and Sweden participated to some small extent[5]

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[1] *I.S.J.*, 1925, 603. [2] *I.S.J.*, 1923, 88-93. [3] See advertisement elsewhere.
[4] *I.S.J.*, 1925, 89, 141. [5] *British and South African Export Gazette.*

Correspondence.

MILLING UBA CANE.

To the Editor, "The International Sugar Journal."

Sir,—I am very much interested in the article by Mr. R. F. Hutcheson in your December issue on the Milling of Uba cane in Natal. The subject is very fully discussed, but I believe that due credit is not given to the use of the Searby Shredder as against the use of the Double Crusher for handling Uba cane. Under the heading of Shredders, Mr. Hutcheson states that the chief reasons against their use seem to be the amount of driving power required, and the cost of upkeep. In discussing power required to drive a shredder, he fails to point out the very great decrease in power required by the mills when treating shredded cane, with consequently a reduction in cost of upkeep in mills.

From figures in my possession, I can state that the horse power required by a Single Krajewski Crusher when grinding 54 tons of Uba cane per hour is 108 indicated h.p. This figure corresponds very closely to 75 h.p for 40 tons per hour quoted by Mr. Hutcheson. The first and second mills treating shredded cane require 174 indicated h.p., and the third and fourth mills 215. The total power required to drive the Crusher and Milling Plant is 497 indicated h.p. when grinding 54 tons per hour. This is 278 h.p. less than would be required to grind 54 tons per hour on the basis of 575 indicated h.p. quoted by Mr. Hutcheson when grinding only 40 tons per hour. The maximum power required by this Shredder is 175 h.p., but the average is nearer 150 h.p.

Much is written about the increase in capacity due to the installation of a Double Crusher, but in a final analysis the Double Crusher is as far behind a Crusher and deep-grooved 3-roller Mill as the latter is behind a Crusher and Shredder and Mills.

For comparison I may cite the returns of a Natal factory and two Cuban factories with greatest average milling rate during the past season. Comparing the work done on the basis of the capacity established by Deerr's formula ($= 0{\cdot}005\ n\ l^2\ d^2$) and alternatively by the tonnage fibre ratio formula used in Hawaii and the Philippines, namely :—

$$\frac{\text{Tons fibre per hour} \times 100}{\dfrac{l^2 \times n}{6}} = \text{Tonnage fibre ratio.}$$

	(1)	(2)	(3)
Arrobas ground per hour		12,363	11,826
Short tons ground per hour	52·90	154·5	147·8
Fibre per cent. cane	14·47	10·85	10·43
Short tons fibre per hour	7·65	16·76	15·41
Nominal capacity (Deerr's formula). Short tons fibre per hour	5·35	17·64	17·61
Actual capacity per cent. nominal capacity	143·0	95·0	87·4
Tonnage fibre ratio	30·3	25·6	23·6
Extraction sucrose per cent. sucrose in cane	91·91	94·6	93·85

(1) = 2-roller Krajewski crusher, shredder, and 12-roller 32 in. × 66 in. mill (Natal).
(2) = Single crusher and 21-roller, 36 in. × 84 in. mill (Cuba).
(3) = Double crusher and 18-roller, 36 in. × 84 in. mill (Cuba).

The extraction figure of 91 per cent. quoted by Mr. Hutcheson is low compared with what is actually being done by a plant with a Searby shredder milling Uba cane. For 1923 the extraction was 91·91 per cent. and for the 1925 season we have reports showing 92·96 extraction for a week, and 92·01 to date, when crushing a much higher quantity of cane than has been reported for a double crusher outfit of like size, namely, 55 tons of cane per hour. I have just learned that 60 91 tons per hour have now been milled on a weekly average in this 32 in. × 66 in. 14-roller mill with shredder.

Yours faithfully,

D. M. Semple.

THE PETERBOROUGH BEET FACTORY CONTRACT.

To the Editor, "The International Sugar Journal."

Dear Sir,—Referring to the remarks regarding the new Peterborough beet sugar factory under "Notes and Comments" in your January issue, we shall be much obliged if you will, in the interests of British sugar machinery manufacturing firms generally, correct what we are afraid will cause some little misapprehension regarding the relative costs of British and American equipment.

As the nearest British tenderers referred to in your comment, we should like to point out that the figures quoted are somewhat misleading and do an injustice to British manufacturers.

The larger quotation of £296,000 included some sundry items not covered for in the successful tender. If these items and other differences in the specification are taken into account the British quotation would approximate very closely to the successful American one.

Whilst drawing attention to this matter we congratulate our competitors, the American firm concerned, in obtaining this particular contract and wish them every success in carrying it through.

Yours faithfully,

Caledonia Engine Works,
Paisley.

A. F. Craig & Co., Ltd.
Thos. C. A. Fairs.

[Our report was based on statements both in the press and in Parliament. But we are glad to publish this explanation of the difference between the American tender and the lowest British one. Possibly the desire to obtain the benefit of the wide experience possessed by the successful American firm dictated the final decision. In any event it is not a dead loss to British machinery manufacturers, since several of them are bound to get the orders for that proportion of the machinery which will necessarily be made in this country, for reasons connected with the sugar subsidy.—Ed. *I.S.J.*]

Publications Received.

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Vade-Mecum de Sucrerie. By Léon Pellet and Paul Métillon. Second Edition, revised. (Journal des Fabricants de Sucre, Paris.) 1925. Price: 15 francs.

This is a useful book, the first edition of which will be known to many readers already. It is a *recueil* of all kinds of calculations relating to cane and beet sugar manufacture, as: in diffusion, the water to be added, the draw-off, the weight of exhausted slices, the volume of press-waters; in cane milling, the volume of juice, the weight of bagasse, and the dilution resulting under varying conditions; in clarification, the quantity of lime or of milk-of-lime to be added, the weight of scums, and lime-kiln data; in evaporation, the weight and volume of the syrup, the evaporation per cent.; and so on for boiling, crystallization, yields, and chemical control. The volume will be of service to most sugar-men. Even in the case of many to whom these simple methods of computation are known, it is of some value to possess the actual examples culled from practice which here appear; whilst for the student such a collection of problems will certainly be of very great help.

Optische Messungen des Chemikers und des Mediziners. (**Optical Measurements for Chemists and Medical Men.**) By Dr. Fritz Löwe. With 34 illustrations. (Verlag von Theodor Steinkopff, Dresden and Leipzig.) 1925. Price: 7.20 RM (bound).

In this book of optical measurements for the use of chemists and doctors, Dr. Löwe, a prominent member of the Zeiss staff in Jena, deals with spectrometric, refractometric and interferometric determinations. Under "Refractometry" he describes the principle and construction of various types of refractometers, including the two new sugar instruments, one for use on the bench in the ordinary way, and the other for observation through the side of a vacuum pan or crystallizer; and also including the Abbe with heatable prisms and an improved dipping design. There is also a section on the practical methods for the application of the refractometer in different industries, that of sugar receiving quite adequate attention. Polarimetry, however, in this volume receives only incidental notice.

Zuckerrohr (Sugar Cane). By Dr. H. C. Prinsen Geerligs. Bangerts Ausland-Bücherie, Nr. 26; Woltmann-Bücher, Bd. 2. (Walter Bangert, Hamburg) 1925. Price: 5 RM (bound).

This is one of a series of small monographs on the crops of tropical countries, and surely its writing could not be in better hands. It covers briefly and clearly the botany and chemistry of cane; its cultivation; the diseases and pests to which it is subject; its harvesting and working up; the products which are obtained from it; and finally gives an historical and geographical survey and some germane statistics. It therefore contains a considerable amount of condensed information. An English version of it would probably be appreciated by many.

South American Handbook, 1926. Edited by J. A. Hunter. (South American Publications, Ltd., London). 1926.

This well-known guide is brought up to date, among the addenda included this year being descriptions of many towns and places not hitherto detailed; a chapter on books on this part of America: and a series of maps. Moreover, the large coloured map appearing as a frontispiece is amended and improved. This is a particularly valuable book of reference for all who have to do with South America, Central America, and Mexico.

Geschichte der Rübe. By Prof. Dr. Edmund O. von Lippmann. (Julius Springer, Berlin). 1925.

After having perused his earlier works on the history of the sugar industry, his "Geschichte des Zuckers," and "Entwicklung der deutschen Zuckerindustrie von 1950–1900," students will be yet further indebted to Prof. VON LIPPMANN for this his latest volume. This gentleman, and profound and industrious scholar, here gives the results of his researches into the records of the sugar beet as a cultivated plant, from its earliest days of which any record can be traced, up to the time of the appearance of ACHARD's great work in 1809. He tells us, for example, that the first definite mention of the beet in early literature appears to be one contained in a list of the plants of the gardens of one of the Babylonian Kings (who lived about 722-711 B.C.). But it would appear to have been known in Sicily and on the shores of the Mediterranean for at least 1000 years B.C. His book is of absorbing interest, and is one which surely will be greatly appreciated by all concerned with the cultivation of the sugar beet and the manufacture of sugar from it.

Among new companies recently registered are the following:—United Molasses Co., Ltd., Bush House, Aldwich, W C. 2. (Reg. No. 210,819). To acquire all the issued shares in the capitals of the Pure Cane Molasses Co., Ltd., and the British Molasses Co., Ltd. Nominal capital £1,000,000 in £1 shares (350,000 8 per cent. cumulative convertible preference and 650,000 ordinary). Regarding this flotation it may be noted that the Pure Cane Molasses Co., Ltd., has heretofore mainly confined its attention to the purchase and sale of molasses, owning and controlling directly or through subsidiary companies, the necessary tank storage, road and rail tank cars, and other equipment in connexion with the storage and land transport of the material. The British Molasses Co., Ltd., on the other hand has owned and operated the ocean tank steamers. The two Companies have branches in Liverpool, Birkenhead, Hull, Greenock, Glasgow and, through subsidiary companies, in Holland, Germany, Italy, South Africa, and Java; and the total capacity of the tank depôts is 250,000 tons. This issue offered the public in January, 1926, was heavily over-subscribed.

Review of Current Technical Literature.[1]

SIZE AND CAPACITY OF CENTRIFUGAL MACHINES USED IN JAVA FACTORIES. *H. E. Lesueur, T. van der Linden*, and others. *Archief, 1925, 33, 4e deel, 3e afl., 114-117.*

In a discussion taking place at the last meeting of the Java advisers, the relative merits of electric, belt, and water drive for fugals were discussed, the speakers, in general, giving preference to the three types in the order just named. One placed the maintenance costs of the first two at 46 and 108 Dutch florins per annum respectively. As to size, H. E. LESUEUR liked the 30 in. for pre-drying the molasses massecuites, and 36 in. for all others. Others, in general, considered the small machine more suitable for dealing with low massecuites, and the 42 in. for first massecuites, though if the grain is good (as at Modjo s. f), the larger gives satisfactory service in this respect. Regarding relative capacity, the Chairman of the meeting, Dr. VAN DER LINDEN, contributed the following figures, which are of some interest.

	Size inches.	Charge kilos.	Time min.	Kilos per min.
Good massecuite	30	120·5	7	17·2
,, ,,	42	168·7	17	9·9
Inferior massecuites	30	102·8	15	6·9
,, ,,	42	169·6	51	3·3

But if in these results one takes into account the time lost, assuming 3 min. for the women operating the 30 in., and 9 min. for the men at the 42 in., then these relative figures expressing kilos per min. become :—

	Good Massecuite.	Inferior Massecuite.
30 in.	12·0	5·7
42 in.	6·5	2·8

This shows the 42 in. machine at a disadvantage. Actually it will dry 270 kg. with the same number of kilos per min. as the smaller type of machine ; but, especially with very low massecuites, the removal of the sugar is so difficult for the native worker that only a charge of 170 kg. can be used in it.

BOILING PRACTICE IN THE P.I. *William Paterson. Reports of the Third Annual Convention of the Philippine Sugar Association, 1925* ; also *Sugar News, 1925, 6, 166.*

A two-week run was made to compare (1) the "two boiling system" (returning molasses to each strike, and boiling to a more or less constant purity) with (2) the system used at the Pioneer Mill, T. H. In method (1) the first massecuite was boiled at 73-5° purity, taking back molasses into each strike, giving first molasses of about 54° purity for the low grades. In following the Pioneer system, the *A*, *B*, and *C* massecuites were boiled at 86, 77 and 74° purity respectively and the low grade at 54°. A small difference was found in favour of the Pioneer method, calculations based on the actual purities attained showing a saving of 250 tons of massecuite per week under conditions practically equal as regards rate of grinding, and syrup and remelt purities, which saving was actually reflected in a material reduction in the extra fuel consumption. In the two boiling method, or in any other where low grade seed is used for the making of commercial sugar, proper attention should be given to grain formation, when making low grade sugar. After this the author states general rules in regard to sugar manufacture for the refineries. Crystals that are hard and regular will give higher returns than irregular ones, and will make a better keeping sugar than an irregular soft grain. A uniform grain will facilitate the affination operation at the refineries. It is important to boil with a high vacuum in the evaporator and pans, so that the viscosity will be reduced to a minimum, and so that the colour of the commercial sugar is not impaired by high temperatures. Manufacture sugar of good colour, which will materially assist the process of refining. A standard sample of sugar, acceptable by the refiner in grain and in appearance should be given to the head sugar-maker to guide him in making sugar as close as possible to standard. Obviously, one must make a sugar to suit refiners' requirements, not the manufacturers'. Boiling to a fixed standard makes work more interesting, and creates a keener interest, making for better work and better sugar.

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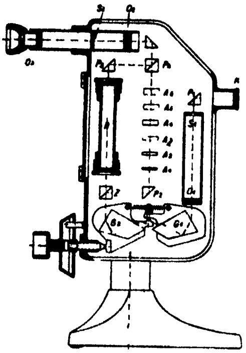
[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

NEW GOERZ COLORIMETER FOR USE IN THE SUGAR INDUSTRY. *Communication to this Journal by the Manufacturers.*

Nearly always colorimetric estimations are carried out by comparing the liquid under examination with a "normal solution" as in the Stammer instrument, or with standard coloured glasses as in the Lovibond tintometer; but, while theoretically this is free from objection, in practice exact comparisons are often difficult and at times impossible owing to there being a difference of shade between the test and the standard. But in the new Goerz colorimeter it is claimed that this source of error cannot arise. With this instrument observations are made by the use of monochromatic light; and it requires no solutions as standards, the necessary absorption of the light being obtained by the use of neutral grey plates, which absorb in the same degree the whole range of the visible spectrum, this enabling the new colorimeter to be employed for the examination of solutions of all colours. Liquid to be examined is poured in into tube *R* of 100 mm. length, similar to a polariscope tube; and on interposing an absorption plate, differences in the brightness of the field of view will become noticed which are compensated by rotating the wave-length drum. Readings give the absorption of the test substance for a certain wave-length, and the concentration of the colouring agent may be found by means of special tables. A high degree of accuracy of observation is claimed for this instrument.



ON THE DRYING OF CANE AND BEET PREVIOUS TO EXTRACTION. *V. Khainovsky.*[1] *Archief, 1925, 33, No. 44, 1175-1185.*

This idea of cutting up cane or beet into small slices, drying, and later (as during the inter-season) working it up is of course very old, having been proposed by GOTTING in 1811,[2] by CROSSLEY in 1837,[3] by NEWTON in 1848,[4] and by others. In regard to cane important work under modern conditions has been done by G. W. MCMULLEN, of Chicago,[5] an account of which is here given, besides which there are the patents taken out by Guanica Central,[6] H. EDSON,[7] and L. GATHMANN,[8] while quite recently some tests made in Madagascar with "cane powder" have been recorded.[9] In regard to beet desiccation before extraction, in 1849-50 SCHÜTZENBACH made a run in the Waghausel factory with slices which had been treated with lime and dried, and other factories tried the process, but it proved to be too costly. A second attempt was made by J. C. F. LAFEUILLE [10] in the years 1901-05, drying being carried out with the use of flue gases first at 300-400°C., then at 200-300°C., and lastly with gases at a yet lower temperature, or in the open air in the sun, preservatives, as sulphur dioxide or formalin, being added to prevent alteration. Slices thus dried were extracted in a simple apparatus operating on the counter-current principle with water at 80°C., to give a juice at 41-54° Brix., this being treated with a little lime and phosphoric acid for its clarification, filtered, and sent directly to the boiling house. But it was found that the desiccation of the slices did not proceed as desired, inversion occurred, the juices were dark coloured, and much molasses were obtained.

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[1] Chemist, the Java Experiment Station. [2] *Bull. de Pharm.*, 3, 371. [3] English Patent, 7469. [4] English Patent, 120, 53. [5] English Patents, 1736 of 1912 and 5145 of 1913; U.S. Patents, 1,040,557, 1,040,562, 1,068,748, 1,058,748 and 1,083,545. [6] French Patent, 440,242. [7] U.S. Patent, 1,068,748. [8] 1,068,758. [9] *I.S.J.*, also *Centr. Zuckerind.*, 1924, 32, 1059, for an estimate of the loss of sugar and costs involved in drying cane.

[10] German Patents, 147,576 and 301,206. *Vereins-Zeitschrift*, 1901, 917; and 1904, 378.

Later Lafeuille[1] took out other patents for the drying of the slices, but this does not appear to have met with better success. Now De Vecchis has taken up the problem,[2] and it remains to be seen how his procedure and plant will operate in large scale practice.

⁂ For other literature on the subject of cane or beet desiccation, one may consult the following: *I.S.J.*, 1910, 307, 313, 634; 1911, 160, 219; 1912, 132, 604; 1913, 37, 193, 245, 495, 543; 1914, 141; 1924, 337, 447; 1925, 391; 1926, 53.

De Vecchis Process of using Desiccated Roots in Beet Sugar Manufacture. *Communication made at the Annual Meeting of the National Farmers' Union, Norwich, January 16th, 1926,*

An important statement was made by Mr. D. J. Coleman of the Farmers' Union as to the proposed new beet-sugar factory at Kings Lynn. He said the proposed factory was to be erected to work the De Vecchis process[3] for drying beets and extracting the sugar afterwards. This invention came to his notice nearly two years ago, and as it seemed well worth investigation he formed a small syndicate among farmers and friends, and they provided money to send experts to Italy. Reports they received were favourable, but they were not able to come to terms as to price for the purchase of the rights to work the patent. Copies of their reports were given to the Ministry of Agriculture, who sent their own experts to Italy. Reports were afterwards issued[4]. Meanwhile Sir Charles Cottier has purchased the world rights of the process, excluding Italy, and has given those for Great Britain to the British Government, in return for which he holds a licence to work the process without royalty in this country. Further experimental work is being carried on at the Institute for Research in Agricultural Engineering at Oxford. Advantages claimed for the invention are these:—(1) A de Vecchis factory will work all the year round instead of four months; (2) as the work is constant, permanent housing schemes will be possible, and there should be great benefit to the neighbourhood generally; (3) the factories require less space than for the diffusion process; (4) the cost is less both for the factory and for the extraction, and therefore it may be possible to pay a better price for beets; (5) it is quite likely that as the subsidy is reduced this process may be the means of operating more economically. Sir Charles Cottier is arranging to form a company in London to work the process, and it is expected that at least one factory will be ready to treat beets dried by the process this autumn in Norfolk.

Alcohol Motor Fuel Production on Queensland. A. de Bavay. *Australian Sugar Journal, 1925, 17, No. 7, 441-449.*

Cost of manufacture of alcohol motor spirit including handling material, crushing or mashing, saccharification, fermenting, distilling, labour supervision, overhead charges, revenues, interest on investments, maintenance, depreciation per gallon of 95 per cent. is estimated as 5d. using molasses or syrups, and at 9d. when working with starch bearing crops. Present cost of denaturing and excise supervision in Australia is 3d., which figure could be reduced by half, or could be eliminated except for about ½d. for excise supervision by blending with petrol. Cost of distribution could not be less than 9d., so that summing up one obtains the following figures:—

	Molasses.	Starch Crops.
Cost of manufacture per gallon	5d.	9d.
Denaturing and excise supervision	3d.	3d.
Other fuel added	1d.	1d.
Distribution charges	9d.	9d.
Total cost—exclusive of material	1/6	1/10

As the molasses generally produced in Australia will give 65 galls. of 95 per cent. spirit per ton at £1 per ton, the cost of material for one gallon would be 3¾d. But molasses can only be secured at £1 per ton if the distillery were established at the mill where it was produced, since molasses costing £1 at Gordonvale would cost 50s. to 60s. per ton in Brisbane, so high is the freight on it. Regarding production from starch-bearing crops, cassava would have to cost less than 15s. 5d. per ton if the cost of 1 gall. of material were to be 5d., and this in "White Australia" is a "hopeless proposition." In the scheme of the Northern Power Alcohol Committee, however, the idea of admixture with say 30 per cent. of benzol is abandoned (this constituent having to be imported), and ether is substituted, 30 galls. of which can be made from 36 of alcohol, the cost of manufacture of which is 1d. per gallon. Under this scheme 540,000 tons of cane would be crushed, but only one crop of sugar (equal to a 60 per cent. yield) would be taken off the evaporator syrup, the rest of the sugar remaining in the molasses being converted to alcohol. In this way 40,500 tons of "mill white" sugar of 94 nett titre would be produced, representing 38,961 tons of 100 per cent. sugar, leaving 32,082 tons of sugar for conversion to spirit, this corresponding to 33,770 tons of invert sugar, plus about 2700 tons of invert sugar naturally occurring in the cane (that lost during manufacture, viz., 418 tons, being deducted). Taking the yield of alcohol from 1 ton of invert sugar as 136 galls. of 95 per cent. alcohol (allowing for a 10 per cent. loss, though in modern practice one of only 5 per cent. is assumed), the total alcohol produced will be 5,148,372 galls. But of this 30 per cent. represents the ether, namely, 1,544,511 galls.; 30 of ether requires 36 of alcohol, or 1,853,413 galls., leaving a difference of 308,902 galls.; so that the total amount of power alcohol would be 4,839,470 galls. This sold at 2s. 3d. per gall. with the bonus of 4d. per gall. gives a gross revenue of £625,098, from which is deducted the cost of manufacture at 1s. 6d. per gall., viz., £386,128, leaving £238,970 to which is added £810,000 the nett revenue from the sugar, giving from 540,000 tons of cane, a return of £1 18s. 10d. per ton.

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[1] French Patent, 326,035, and German Patent, 195,740. [2] *I.S.J.*, 1924,

[3] U.K. Patents, 209,738 and 211,113; *I.S.J.*, 1924, 337.

[4] *I.S.J.*, 1925, 158; see also on the subject: *I.S.J.*, 1925, 391; 1926, 53.

ALCOHOL MOTOR FUEL FROM MOLASSES. II. USE OF ALCOHOL AND ALCOHOL-ETHER MIXTURES. *E. C. Freeland and W. G. Harry. Ind. and Eng. Chem., 1925, 17, No. 7, 717-720.* Continuing this contribution,[1] the following matters are discussed: Advantages of alcohol as a motor fuel; disadvantages; use of alcohol and alcohol-gasoline mixtures; and alcohol-ether mixtures. Results of authors' experience with these fuels are given, together with data on practical tests on automobiles, tractors, and stationary engines, using these fuels under varying conditions.—MILLING INSTALLATIONS OF 174 JAVA FACTORIES. *G. E. Ferguson. Archief, 1925, 33, No. 10, 341-374.* Among other data here given for each factory are: Type of installation (units, crushers, shredders, etc.); dimensions of the rolls; makers of the installations; hydraulic arrangement, etc.—FROM "SEMI-SCALE TO FULL-SCALE." *E Yeakle Wolford. Industrial and Engineering Chemistry (News Edition), 1925, 3, No. 22, 1-2.* Gives a unit cost sheet, and a projected balance sheet of manufacture. A special point made is that not only corrosion wear and tear, but also obsolescence, should be written off in most industrial chemical plant, and in as short a time as 6-12 months. Reference is made to the method recently given by WEISS and DOWNS[2] for finding the unit cost of a plant.—CUTLER'S PROCESS OF PURIFYING MOLASSES[3] *G. Dorfmüller and F. Tödt. Zeitsch. Ver. deut. Zuckerind., 1925, 903-913.* In the first place, Cutler's process is not new.[4] In the second, no real increase of purity is produced by hydrochloric acid treatment, whilst it has long been known that an improvement is effected by osmosis. The economy of the process is extremely doubtful.—USE OF BLUES IN WHITE SUGAR MANUFACTURE IN JAVA. *Archief, 1925, 33, 4e deel, 3e afl., 122.* In the reports of the meetings of the Society of Advisers of the Java Sugar Industry, recently in congress, Mr. RAABE stated that tests made at the Eschauzier factories proved that ultramarine was to be preferred to "Indanthrene"; and Mr. WIJN also stated that in the Factorij factories preference was given to ultramarine in comparison with the same German preparation. Mr Loos said that he had the impression that "Indanthrene" was taken up by the sugar with difficulty.—ACTIVATED

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[1] *I.S.J.*, 1925, 392.

[2] WEISS and DOWNS: "The Technical Organization." (McGraw-Hill Co., Inc.) 1924, pp. 170-174.

[3] *I.S.J.*, 1922, 292; 1924, 621, 665.

[4] Compare, *Vereins-Zeitschrift*, 1876, 13, 979-1001.

CARBONS *vs.* ANIMAL CHARCOAL (BONEBLACK.) ***Chas. Ferguson.*** *Chemistry and Industry, 1925, 44, No, 45, 1096.* "Carboraffin" has about 80 times the decolorizing power of char, the amount used in beet refineries and factories not using char being from 0·056 to 0·10 per cent. of the sugar made. As to the ash removal question, with "Carboraffin" the molasses quotients, compared with those of neighbouring factories, are about 1 per cent. lower. Furthermore, the worst features of char work are the high sugar loss and high steam consumption, both of which shrink to trifling amounts in the case of a powerful active carbon.—SYNTHESIS OF DISACCHARIDES. ***F. Wrede.*** *Deutsch. med. Woch., 1925, 96, II, 1148.* Several disaccharides and trisaccharides containing sulphur or selenium are said to have been prepared. That containing sulphur, for example, has a sweet taste, does not reduce Fehling's solution, and resembles sucrose except that it is not hydrolysed by sucroclastic enzymes.—FERMENTATION OF CACAO SHELL. ***A. Churchman.*** *Journal of the Society of Chemical Industry, 1925, 44, No. 50, 540-542T.* Use of roasted cacao shells as raw celluosic material for production of power alcohol is not practicable, the best results (only 2·65 per cent. alcohol by weight) being obtained when hydrolysing with 0·5 per cent. sulphuric acid under 6 atmospheres' pressure.—VALUE OF ECONOMIZERS IN CANE SUGAR FACTORIES. ***H. von Ranzow.*** *Archief, 1925, 33, 839-841.* After reviewing the possibilities of the installation of economizers in cane sugar factories, and the factors attending their profitable utilization, it is concluded that they may be installed when a high production of steam from the boilers is demanded; or when the temperature of the flue gases is usually great, due to working at a high pressure.—PREPARATION OF RAFFINOSE. ***D. T. Englis, R. T. Decker, and A. B. Adams.*** *Jl. Amer. Chem. Soc., 1925, 47, 2724-2726.* In outline the process consists in extraction of cotton-seed meal with methyl alcohol, evaporation of the spirit, addition of water, extraction of oil with petroleum ether, treatment with basic lead acetate, filtration through decolorizing carbon, precipitation of excess of lead, re-filtration through carbon, concentration to 80 per cent. solids, and crystallization. Yield, about 2·5 per cent.—CULTIVATION OF SUGAR BEET IN INDIA. ***P. B. Sanyal.*** *Agricultural Journal of India, 1925, 20, Pt. V.* Previous trials made in 1923-4 at Pusa, Bihar, India, have shown that yields of good quality roots can be obtained there; but these now made show that it is possible to have supplies of roots from the middle of March to the middle of May, that is, over a sufficiently long period after the end of the cane season. Sugar in roots, 14·7 per cent.; purity of the juice, 85°; yield of roots, 10·3–12·5 tons; calculated amount of sucrose, 1·79 tons per acre, that is, results comparable with European practice.—GROWTH OF THE DATE PALM. ***Silas C. Mason.*** *Journal of Agricultural Research, 1925, 31, No. 5, 401-453.* Questions studied are: (1) Minimum temperature for growth of the date palm, and the absence of a resting period; (2) Partial thermostasy of the growth centre of the date palm; (3) and the inhibitive effect of direct sunlight on the growth of the date palm. Normal growth occurs between sunset and sunrise; also in daylight when direct sunlight is cut off by clouds; whilst it can also be induced in darkness, and likewise in the brilliant illumination of a battery of electric lamps. But growth is inhibited in a dark-room exposed to the rays of the Cooper-Hewitt mercury vapour tubes.—CAPACITY OF MILLS IN P. I. AND IN CUBA. ***Herbert Walker.*** *Sugar News, 1925, 6, No. 11, 701-702.* In the P. I. a 12-roller, 34 in. × 78 in. mill is rated as having a capacity of 1200 metric tons of cane per day of 24 hours; but in Cuba a mill of this size ordinarily grinds at least 2400 tons in the same time, and even 3900 tons have been reported when the speed of the rolls was 33 feet per minute.—FORMULÆ FOR CLOTH FILTRATION. ***A. J. V. Underwood.*** *Paper read before Institution of Chemical Engineers, January 13th, 1926.* Rate of flow through cloth appears to be proportional either to the square or the square root of the pressure according to the type of the cloth and the nature of the precipitate. Approximate formulæ are here evolved based on the assumption that the relation between the time of filtration, and the volume of filtrate, at constant pressure, can be expressed by a parabolic curve. This holds good for precipitates likes calcium and magnesium carbonate; but, from unpublished experiments on the filtration of "compressible precipitates," the resistance of such appears to be approximately a linear function of the pressure of filtration.
J. P. O.

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Notes and Comments.

Death of Sir J. B. Harrison.

We regret to have to record that Sir J. B. HARRISON, of the Department of Science and Agriculture of British Guiana, died last month at Georgetown, just on the eve of his retirement from active work in that colony. In him a notable personality has been removed. He was an exceedingly able man, possessed of a large amount of knowledge in many fields; an untiring worker and an extremely accurate one.

He started his career in the colonies as Island Professor of Chemistry and Agricultural Science in Barbados in 1879, becoming in 1889 Government Analyst and Professor of Chemistry in British Guiana, where since 1904 he held the post of Director of the Department of Science and Agriculture. HARRISON's name will always be associated with that of BOVELL in connexion with the re-discovery in Barbados of the fertility of sugar cane seed.[1] Yet he was primarily a chemist and geologist and not a botanist For his services he was made a C.M.G. in 1901 and was knighted in 1921.

Besides his work as a geologist, both in Barbados and in British Guiana, HARRISON did a vast amount of work on the best methods of manuring the cane fields in the latter country. He also devoted himself with enthusiasm to the raising of new seedling canes for the local conditions. In the course of his investigations in this line he early observed that certain varieties of little commercial value produced masses of seedlings, apparently by self-fertilization. Of these about two-thirds resembled their parents and among the rest considerable variations occurred. But on the whole the seedlings were of little value, and these parents were soon discarded in favour of such well-tried canes as D 625, Bourbon, White Transparent, and Red Ribbon. HARRISON worked almost entirely by self-fertilization and did not attempt crossing. His method of selection was elaborate. The first stage was, as now, the selection of suitable parents, and the picking out of their seedlings which showed most vigour, had good cultural characters and, lastly, rich juice. But, because of the importance of ratooning in British Guiana, he added severe tests in this direction, growing the seedlings on in plots till the fourth year, and eliminating any that failed in any year. After this stage had been completed, he appears to have planted them out on small plots for manurial tests, thus obtaining an insight into their food requirements. When the series was completed he averaged the yields of each seedling on all the plots, those receiving special doses and the no manure plots between; and by comparing the averages of the different seedlings he considered that he was able to indicate which of them was best suited for growth in the local conditions. The present day state of the industry, we may add, does not allow of such a lengthy period of trial. Cross-fertilization is considered of great value, but otherwise the selection work in the first stage is identical; and, where possible, the seedlings are also tested for resistance to disease. It is now usual to leave ratooning power and manurial requirements to a later stage, namely, when they are in the hands of planters. This is all the more necessary because of the great diversity of the individual fields cultivated.

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[1] See *I.S.J.*, 1925, 348.

The De Vecchis Process in this Country.

The British Sugar Beet Society has thought fit to issue some comments on the situation engendered by the plans to introduce the De Vecchis process of drying beet slices into our home sugar industry. The Society notes that the Commission instituted by the Ministry of Agriculture to enquire into the De Vecchis sugar process is of opinion that the whole question of the practical application of the principles of the system is still open, and that the Commission has recommended that a complete plant of a small capacity, but on a factory basis, should be set up in England, in order to test the process experimentally, which the Society assumes will be done at the public expense. The Society considers that in the meantime the system must be regarded as in the experimental stage and its commercial possibilities unproven, and that the known results are not such as should discourage the investment of further capital in the methods of sugar manufacture now in use, or sugar beet growers from entering into contracts with existing factories.

Meanwhile, we remind our readers that the idea is at least 75 years old, but nevertheless has been found impracticable so far on the Continent. It is a question in the first place of dehydrating the roots in such a manner that they are not damaged, and in the second place of fuel economy. Certainly it is an experiment worth trying, as if success were achieved it would solve a big problem in the beet sugar industry; but it would be a mistake at this juncture to be too sanguine as to the successful outcome of the present experiments, considering that the idea has been under investigation on and off for so many decades without tangible results accruing.

The Peterborough Beet Factory.

In our January issue when recording the success of the Dyer Company, an American firm, in securing the contract for the erection and equipment of the new Peterborough beet sugar factory, we expressed an uncertainty as to whether this firm were having a free hand in the design or not. It would appear now that we were under a misapprehension and that there was no question of any European design being stipulated in the plans submitted by the Dyer Company. On the contrary, the latter are having an absolutely free hand in the design of the factory and are taking full responsibility for its performance. At the same time it follows owing to the terms of the sugar subsidy that most if not all of the machinery required will be made in this country. We are glad to make this correction, all the more as it coincides with our own frequently expressed wish that at least one American-designed and American-managed factory should be erected in this country as a basis of comparison with other existing factories of European conception and arrangement. We may add that the Dyer Company have now opened a London office at 50, Pall Mall, S.W. 1.

Some Cost Figures of Home Grown Sugar.

As is inevitably the case when any industry is subsidized there has been a certain amount of criticism of late both in Parliament and in the press, as well as at farmers' meetings, with regard to the share of the beet sugar subsidy secured by the factories. The farmers for instance allege that while they receive 54s. per ton for their beets on a three-year contract, the promoters of the sugar factories receive as much as 58s. 6d. per ton as subsidy from the Government.

This statement has drawn a reply from the Anglo-Scottish Beet Sugar Corporation Ltd., who point out that this figure of 58s. 6d. is somewhat higher than is actually the case; but that in any case it should be borne in mind that the factories have to pay an excise duty of 7s. 4d. per cwt., equal to 17s. 9d. per ton of beets; further that at the present price of beets, viz., 54s. per ton delivered on the basis of 15½ per cent. sugar in the roots, the factory is actually paying to the farmer 22s. 6d. per cwt. for the sugar obtained from the beet. On the other hand the net average price of sugar this year has been about 26s. 10d. per cwt., which compares with 30s. 10d. a year ago and 55s. 3d. in 1923-24.[1] To the 22s. 6d. has to be added the excise duty of 7s. 4d. to arrive at the cost price per cwt. (29s. 10d.) of the sugar before the beets are touched, a deficit of some three shillings. It will be seen, then, on the Corporation's showing that in order to carry on the very intricate factory procedure, requiring many thousands of tons of coal, coke, and limestone, a huge labour bill, and a large capital investment, and to make a profit, a considerable inroad has to be made into the 19s. 6d. subsidy allowed by the Government, over and above what is needed to wipe out the 3s. deficit indicated above. Then, although the farmers are being paid on the basis of 15½ per cent. sugar in the roots, the factory assumes that only about 12 per cent. is extractable; and in a bad year, such as the one just past, 12 per cent. would be a pretty good performance. It allows for no loss of sugar while the beet is in storage at the factory, and such losses can be considerable in inclement weather.

Beet Sugar in South Africa.

The establishment of a beet sugar industry in South Africa is reported as under consideration by the Union Government. The reports of the Department of Agriculture experts are said to be promising and suggest that South Africa contains much land suitable for sugar beet cultivation, while it would suit the labour requirements of certain districts settled with whites. In the view, however, of the *South African Sugar Journal*, the thing would not be economically possible for the sugar industry as a whole. At the present moment the cane sugar industry is producing about 70,000 tons above the capacity of the country to consume, and to start beet sugar making under such conditions would necessitate a very much greater degree of protection to give it a chance to succeed. Without such protection it would, our contemporary avers, be doomed to failure from the outset. Certainly beet can be grown in that country to yield a high sucrose content, but cane could also be grown for practical milling in many other parts of South Africa, notably in the Transvaal, in the Midlands of Natal, in Rhodesia, and in the Northern Cape Province. Comparison can be made with Australia which has had one beet factory for years that has been a success, but no steps have been taken to establish any others. It would seem, then, a fair contention that South Africa should confine its sugar interests to cane, so long as this can more than meet the requirements of the population and the scope for an export trade. The justification for beet lies in more temperate regions where it is a case either for indigenous beet sugar production, or else for importing cane sugar from other countries.

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[1] While the farmers in those two previous seasons received on a three-year contract 46s. 5d. and 55s. 3d. respectively.

The United Kingdom per Capita Consumption.

The Board of Trade figures of the home consumption of sugar in the United Kingdom (which comprises England, Scotland, Wales and Northern Ireland) for the calendar year 1925 were given in our January issue (page 63) as 1,662,982 tons (to the nearest ton). This total includes refined and raws but not molasses. It turns out, however, that it does not include the quota of home-grown sugar that was consumed in this country, so an addition is necessary to the figures to arrive at the actual amount of sugar presumably consumed in this country. Unfortunately we have no published figures of the amount of sugar produced in the home campaign of 1924-25 that was consumed in 1925 nor can we say with any absolute certainty how much of the sugar produced in the 1925-26 campaign was consumed up to December 31st, 1925. But it will probably not be far out if we reckon that out of the home production of beet sugar in 1924-25 amounting in all to 25,000 tons, 10,000 tons belong to 1925; and out of the estimated production of 60,000 tons during 1925-26, 30,000 tons may be ascribed to the year 1925. This agreed, we arrive at a consumption of home grown beet sugar during 1925 of approximately 40,000 tons, which amount should be added to the above-mentioned 1,662,982 tons, to arrive at the total of sugar consumed in the United Kingdom, viz., 1,702,982 tons.

The population at the present day according to official sources being 45,064,000, the average per head of the community works out at 84·65 lbs. of sugar. As for the molasses, there are no data extant, so far as we are aware, for analysing them in terms of sugar, but if we assumed the figure to be 20 per cent. of the weight of molasses, it would only increase the consumption by two-thirds of a lb. It may be added that the Board of Trade now estimate separately the amount of molasses going into use in distilleries and as food for stock; in 1925 254,073 tons were so disposed of and were entered free of duty. Four-fifths of it was imported molasses.

Australia's Sugar Consumption.

In our last issue we referred to the contrast between the U.S. consumption of sugar per head and that of Australia, which latter, taken from official statistics, was quoted as being no less than 138 lbs. But the *Australian Sugar Journal* points out that this is not the net amount actually consumed in Australia; "it includes large quantities sent away or locally used in the form of manufactured commodities, such as jams, tinned milk, beer, etc. Even so, the figures are far in excess of those of any other country. From an authoritative source we learn that the actual quantity of refined sugar sold in each year from 1920 to 1924 (inclusive) was as follows:—280,291 tons in 1920; 251,109 in 1921; and in the succeeding years respectively—268,171 tons; 284,375 tons; and 305,902 tons. Adding to these figures the quantity of treacle and golden syrup sold during the same periods, we get the following averages for the years:—Total lbs. per head of population, 122·74 lbs. for 1920, when the population of Australia was 5,295,864; 105·27 lbs. in 1921; 110·14 lbs. in 1922; 114·55 in 1923; and 120·39 lbs. per head in 1924. It will be recognized that the export trade has a large influence upon these figures; but it is at least encouraging to find that the consumption per head of population has been consistently progressive since 1921."

A Cuban Crisis.

There is no denying, in the opinion of a writer in the *Cuba Review*, that the sugar industry of Cuba is passing through a serious crisis, as the result of the low price at which sugar has been selling for some months past. During most of 1925 sugar of 96° polarization averaged but 2¼ cents per lb. Ten years ago with the comparatively cheap labour that prevailed in all parts of the world, sugar might have been made in Cuba and sold at that figure with a small profit. But to-day under present conditions, out of the 185 centrals it is said that not more than a dozen can balance matters, let alone make a profit. The others will be faced with bankruptcy unless some way is speedily found either to increase the price or materially lower the cost of production. The colono has agreed under Government pressure to deal with the present crop, but he refuses to put another field under cane under present conditions since it would mean a heavy financial loss for him. The custom in Cuba is for the planters to sign contracts with the centrals for a period of years to grow and deliver cane at a given ratio of payment, which averages 125 lbs. of sugar for every 2500 lbs. of cane delivered. Now most of the present contracts were made several years ago when sugar was selling at 4 cents per lb. At that price there was a fair profit for both central and colono, but at 2¼ cents there is a loss for both. At the beginning of the present grinding season the colonos were on the verge of rebellion. They demanded a larger proportion of sugar as payment. The mills replied that since there was an unavoidable loss, the colonos should share it with the centrals. During December threats to stop cutting cane were made in a number of districts, and the good offices of the President were called in to straighten out the muddle. He failed to secure any satisfactory settlement, but did at least succeed in getting the planters to agree to deal with the present crop, pending a definite solution of the dispute. The President then appointed a special sugar Commission to go into the matter fully, and endeavour to suggest a satisfactory remedy.

Many are the remedies suggested, according to our contemporary. Some claim that the acreage must be cut down and production limited. But Cuba would be reluctant to lose her present hold on the world's market, supplying as she does over 25 per cent. of the world consumption. Cuba naturally wants the U.S. tariff modified in her favour, but as it would probably result in her marketing direct consumption sugar in the States at 4 cents per lb., in flat competition with the American refineries and the western beet sugar producers, this is not a consummation she is likely to witness in the near future. What Cuba must do is to endeavour to lower the cost of production. She is now finding out the fatal mistake of having in the past reaped cane year after year from the same land without renewing the plant food taken from the fields. She could have afforded to remedy this some years ago when sugar fetched 4 cents; now she will have to do it by hook or crook if her production is to be kept up, as new lands suitable for sugar cane are not plentiful in Cuba and the renewal of the old fields is a pressing necessity. Apart from the need to restore the exhausted soil, much will come from the extension of mechanical operation in lieu of hand labour, and if a satisfactory cane cutting, stripping and topping machine can be produced, a very considerable saving in labour cost seems certain. But the wholly satisfactory machine of this type has still, we fear, to be invented, though there are some on the market already that succeed to a certain extent.

Jamaica Sugar during 1924.

The Colonial Office report on Jamaica for 1924 states that the sugar crop that year suffered greatly from the drought. The total sugar production was 34,334 tons as compared with 39,049 tons in 1923; the exports were slightly under 23,000 tons, valued at about half a million sterling, as against 26,000 tons valued at £675,000 in the previous year. Rum, however, again became saleable at good prices, and an increase in quantity (nearly 200,000 gallons) and in value (£70,000) was recorded for the rum exported in 1924 as compared with 1923. The continuance of the State aid to the estates was effective in tiding over a difficult year for the planters; these are now faced with severe competition in the sugar markets of the world from the recent increase in sugar production, while they continue to labour somewhat under the effects of the unfortunate over-capitalization of 1919 and 1920. It is, however, an advantage to have recovered a favourable trade for Jamaica rums.

The campaign against mosaic was continued by the Department of Agriculture; good progress was made in many quarters, and there are plenty of estates now where the disease has been reduced to sporadic cases. The Uba cane has proved of great service and has enabled several estates to place their cultivations on a greatly improved basis, while factory results have shown that the Uba offers no serious difficulties in manufacture. The Department of Agriculture established a record during 1924 by the distribution of 937,489 cane tops and cuttings to the planters, or more than twice the number for the previous year. The outstanding new varieties of cane were the Uba and the Barbados seedling BH(10)12.

Experiments conducted in the Government Laboratory have shown that the local white sugar could be successfully employed for making condensed milk; and it is under consideration to start a condensed milk plant on a Government farm to supply the public institutions of the island.

The British Empire Producers Organization have recently decided to press the Government to consider such a rearrangement of the drawback paid on the export of goods manufactured from Empire sugars as to allow the freer sale of Empire sugar to confectioners in this country manufacturing for export.

We learn that the Froghopper Investigation Committee in Trinidad had a meeting at the end of January when arrangements were made for the appointment of Mr. P. E. TURNER, Lecturer on Chemistry at the Imperial College, to carry out the chemical investigations connected with soil problems; and with the approval of the College authorities Mr. TURNER will be seconded for service for a term of years with the Froghopper Committee. A good deal of general information is being collected by the Committee for future study.

According to the Customs returns for the year 1924, the exports from Barbados amounted to 35,671 tons of vacuum pan crystals, 5668 tons of muscovado sugar, 5,987,453 wine gallons of molasses (say 54,431 puncheons), the total value being placed at £1,522,796. The fancy molasses which comprises the vast bulk of the molasses turned out is reckoned as equal to 13,153 tons of sugar; the total sugar crop then if no fancy molasses had been made would have been 54,493 tons, or 8218 tons less than the previous year. Over and above that, the sugar consumed in the island came to about 8000 tons.

Fifty Years Ago.

From the "Sugar Cane," March, 1876.

Extracts were reproduced in this issue of our predecessor from a book entitled "The Hawaiian Archipelago" by I. L. BIRD published about this time, and some of these may again be printed here:—

"Sugar is now the great interest of the Islands . . . . . There are 500,000 acres of productive soil of which only one-fifteenth is under cultivation, and of this large area 150,000 acres is said to be specially adapted for Sugar culture. Herein is a prospective Utopia, and people are always dreaming of the sugar-growing capacities of the belt of disintegrated lava which slopes upwards from the sea to the bases of the mountains . . . . ."

"Were water plentiful and the duties removed, fortunes might be made, for the soil yields on an average about three times as much as that of the State of Louisiana. Two-and-a-half tons to the acre is a common yield; five tons a frequent one; and instances are known of the slowly matured cane of a high altitude yielding as much as seven tons! The magnificent climate makes it a very easy crop to grow. There is no brief harvesting time with its rush, hurry and frantic demand for labour, nor frost to render necessary the hasty cutting of an immature crop . . . . ." Then the writer goes on to describe the old-time method of manufacture in the following way: "The cane, stripped of its leaves, passes from the flumes under the rollers of the crushing-mill, where it is subjected to a pressure of five or six tons. One hundred pounds of cane under this process yield up from 65 to 75 lbs. of juice. This juice passes, as a pale green cataract, into a trough, which conducts it into a vat, where it is dosed with quicklime to neutralize its acid, and then run off into large heated metal vessels. At this stage the smell is abominable, and the turbid fluid, with a thick scum upon it, is simply disgusting. After a preliminary heating and skimming it is passed off into iron pans, several in a row, and boiled and skimmed, and ladled from one to the other till it reaches the last, which is nearest to the fire, and there it boils with the greatest violence, seething and foaming, bringing all the remaining scum to the surface. After the concentration has proceeded far enough, the action of the heat is suspended, and the reddish-brown, oily-looking liquid is drawn into the vacuum-pan till it is about a third full; the concentration is completed by boiling the juice *in vacuo* at a temperature of 150° and even lower. When the contents have thickened into the consistency of thick gruel by the formation of minute crystals, they are allowed to descend into a heater, where they are kept warm till they can be run into "forms" or tanks, where they allowed to granulate. The liquid or molasses which remains after the first crystallization is returned to the vacuum-pan and reboiled, and this reboiling of the drainings is repeated two or three times, with a gradually decreasing result in the quantity and quality of the sugar." Lastly the writer described the process of spinning the massecuite.

Two patents were abstracted in this issue. The first[1] related to the well-known Pzillas process of making cube sugar, and consisted of a circular drum, rotating vertically, containing moulds around its periphery its rotation being intermittent so as to allow a stamp to come forward and compress the sugar in the moulds. The second,[2] communicated by MIGNON and ROUART, of Paris, was for extracting sugar from cane in a manner similar to that used for treating beet, in that grinding or pounding machinery was used for obtaining a finely divided mass.

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[1] English Patent 2486 of 1875. [2] 2647 of 1876.

The Coimbatore Cane Breeding Station.

There are one or two points of special interest in the Report of the Indian Sugar Cane Expert for 1924-25 which has just been received. In the first place, we learn from the short concluding paragraph that, after a period of over 12 years of probation, this station has been placed on a permanent basis. Such probation is usually accorded to all projects which the Government of India has not satisfied itself are likely to be of permanent value to the country, or are not likely to repay the capital expenditure entailed by the engagement of a permanent staff. Various methods may be adopted of meeting current expenditure, but when a new department is opened, its cost has to be capitalized; and unless there is a comparatively large amount of money available for this purpose the temporary expedient has to be adopted. This system has undoubtedly acted adversely on agricultural development in the past, it being essentially a project with very slow beginnings, although illimitable in its ultimate scope. And it was, we believe, only the presence of a very large sum of money under the heading of accumulated railway earnings that enabled Lord CURZON to start the present Agricultural Department on a sound and sufficient basis: a department which, by the way, has so abundantly justified itself. The temporary nature of the office of the Sugar Cane Expert was of course primarily due to these considerations. But this does not explain why the temporary expedient has been continued for so long: no one can explain that without an intimate knowledge of the entanglements and mentalities of successive "finance members." But the circumstances were peculiar from the outset. Although the work of the station was primarily intended for the benefit of the great cane areas of North India, the headquarters were located at Coimbatore, some 1500 miles to the south: for the very sufficient reason that the work could only be done there. The first officer appointed was one due shortly to retire, and although his period of service was extended for four additional years, it was some time after his retirement before a successor was appointed. He was fortunate enough to be able to leave behind, as a legacy, the Sugar Bureau, whose acceptance by the Government has been of such signal value in testing and pushing the new seedlings evolved, in North India. Meanwhile, the actual work at Coimbatore was continued by the present incumbent on the lines laid down; and in due course he was placed definitely in charge. It is unnecessary to labour the disadvantages of a temporary department in India: suffice it is to say that these are always considerable, and great credit is due to the staff for the enthusiasm with which they have carried on the work in spite of all obstacles. The Sugar Cane Expert is right in acknowledging the way in which the Government of Madras has assisted by the allocation of men and the loan of buildings, as well as the cordial interest taken in the station by the various Madras officials. For reasons difficult to explain (we believe that they had a close connexion with the allocation of funds) the staff was entirely under the Madras Government, while almost wholly engaged on Government of India work. Altogether it was a somewhat hazardous experiment, as are all projects with dual control or none at all; and we congratulate all concerned that, at long last, the small department is now given its true status. The first result of this appears to be that, after several years in which no Report was printed for distribution, it is added for the first time to those of the various experts working at Pusa, signifying that the office is now under the direct control of the Agricultural Adviser to the Government of India.

The second point of interest lies in the fact that a new class of cane is producing fertile flowers on the station, namely that of the Mungo group. As is by now well known to the readers of this Journal, the cane rarely flowers in north India, and in those few cases where it does the stamens, at any rate, are sterile. And because of this, one of the first pieces of work conducted by the newly appointed Sugar Cane Expert was to tour extensively through the great northern tract, study the cane varieties on the spot, and send down parcels of them to be grown on at Coimbatore. The idea was to cross them with various better canes, and thus obtain hybrids of an intermediate character, which might prove superior to the local canes, while at the same time hardy enough to withstand the climatic and other disadvantages of the northern tract. On the whole this programme has worked out successfully. But it was soon noted that the varieties brought down from north India varied greatly in their flowering capacity, and consequently in the production of seedlings. Once the introduced canes were acclimatized, it was seen that most members of the Saretha group flowered well and produced masses of seedlings: flowers were sparse in the closely allied Sunnabile group. the members of the Pansahi group gave a beautiful show of arrows but few seedlings; while the Nargori group only produced abnormal inflorescences with barren flowers, and Mungo did not flower. Now the two latter groups have, both of them, characteristics of value: the Mungo canes are comparatively thick and have great tillering power, thus suggesting their resistance to lodging, so common in the Saretha group on the light alluvial soils; while the Nargori varieties have a beautiful upright habit, are extremely resistant to unfavourable climatic and soil conditions, and some at least have very sweet juice. The production of flowers in the Mungo group during the past two years is thus a matter of great congratulation, and will, it is hoped, some day be followed by tbe remaining Nargori set. Seedlings have, we see, been promptly raised from Mungo parents. Parenthetically, we may remark that during the first seven years of the station's existence, considerable progress was made in the study of the morphology and classification of the indigenous Indian canes; bu we have at present no knowledge as to whether this work is being continued. Naturally, such study must form the basis of all scientific seedling work; and, as a writer has recently pointed out, there is still much to be done.[1]

During the year "over 200 cross-pollinations, involving operations on about 1500 arrows, were made. These gave about 200,000 seedlings, and a large number of them possess very satisfactory vigour of growth." It is obvious that the work of selection of the few set apart each year for further growth must be very engrossing; and we should value some indication of the direction in which the selection of seedlings is tending. The local technique of breeding continues to develop, and the most various methods are being introduced by which the labour involved in selection may be reduced. For instance, cylindrical rings are being substituted for the ordinary seed pans for sowing the inflorescences, while the seedlings are being pricked out direct on to raised beds of earth: this with the laudable object of giving more scope for root development. We presume that the danger incurred by the very occasional heavy rains during the dry season is duly guarded against. As elsewhere, experiments are being tried of separating the inflorescences from male parents and treating them to solutions in the hope of influencing their availability, and possibly their fertility. Seedlings are also being sent up north for testing the possibility of raising them in closer contact with their future conditions of growth. Lastly, now that mosaic has been definitely found in the Indian canefields, a careful study of its occurrence in south India is being conducted, as indeed is being done in all sugar cane provinces.

The behaviour of the Coimbatore seedlings in Bihar is dealt with in the Report of the Secretary of the Sugar Bureau: here we have some interesting information about the success being obtained in the Punjab and the western portion of the United Provinces adjoining. The behaviour of Co 205 without irrigation in the Gurdaspur farm, and also under swamp conditions in the cultivators' fields is illustrated by photographs. In each case it is claimed that the seedling produces 50 per cent. more gur than the surrounding local canes. The author remarks on its wide range of resistance "it is essentially a poor man's cane, puts up with indifferent conditions, and shows up all the better in a bad year."

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[1] *I.S.J.*, 1925, p. 529.

C.A.B.

The Economics of Beet Sugar Production in the United Kingdom.

Mr. ALFRED WOOD (Secretary of the British Beet Sugar Society, Ltd.) addressed on February 17th a meeting convened by the Sankey Sugar Company, under the auspices of the Lancashire and Cheshire branches of the National Farmers' Union, in the course of which he said:—

It is generally believed that Mr. SNOWDEN'S subsidy proposals, subsequently passed into law by the Conservative Government, constitute the first grant of State assistance to this new industry. This is not the case. The subsidy took the place of, and is less in value than, the remission by the Coalition Government in 1922 of the excise duty, which is now re-imposed. The new method of State help, being for a definite period on a specified diminishing scale, has an advantage which the former method had not. It has brought capital into the industry for the building of factories because the investor has been able to estimate the amount of State support which could be counted upon for a term of years and frame his estimates accordingly. Another statement has also been made from which misleading inferences have been drawn, namely, that the subsidy per cwt. of sugar calculated per ton of beet is greater than the beet price. This is true only if the factory is fortunate enough to secure a high extraction of sugar from the beets. Even at that high extraction the beet price is actually higher than the value of the sugar, pulp, and molasses in the beets before they leave the field. This in itself proves the statement made by the Ministry of Agriculture that the price of 54s. per ton compared with the Continental price of 25s. to 30s. per ton suggests that the subsidy is about evenly divided between grower and factory.

Individual statements as to farmers' costs or a series of sample costs cannot be taken as a reliable guide. The Society has always pointed out the danger of overstating the case from the farmer's standpoint, either with regard to his costs or his possible profit. General experience has, however, led to the belief that at present prices a yield of 8 or 9 tons of beet per acre will show a fair profit, and a yield of 11 or 12 tons a handsome profit, without taking into account the value of the tops and leaves, if calculated upon the actual area of the land cropped. It has also been said by some growers that the addition to the price by reason of a favourable sugar content higher than 15½ per cent. has met practically the whole of the transport charges upon their beets to the factory.

The beet sugar industry differs from other industries in that the factory has to pay for its raw material at the highest rates in those early years when it is needed at the lowest rates, both parties to the transaction having to gain experience at the same time. The industry represents a long continuous series of operations in two sections, agricultural and manufacturing, the beet price being the bridge between the two; so that the incentive to enterprise, which we call profit, can be reserved to both interests. Each of these operations, from the preparation of the land for the crop to the marketing of the final sugar products, exceeds in cost the corresponding operations in the Continental sugar beet industry which has had nearly a century of experience, training and organization to reach its present efficient and economic production. The margins of excess cost are small but their cumulative effect upon the total cost is large and the subsidy percolates through the whole series of operations making them in the meantime worth while, thus providing employment and the acquisition of practical education. Small savings upon each of these operations can and will be made as experience in this country approaches the Continental standard. These savings may reasonably be expected to have a similarly large cumulative effect, intensified by the wider area over which the costs can be covered, in the farmer's case by an increased average yield per acre actually grown, and in the case of the factory by a larger average daily throughput and a higher rate of extraction. If these savings can be accomplished at a rate corresponding to each fall in the rate of subsidy, then a lower beet price does not necessarily mean a lower rate of average profit for the farmer or such fall of subsidy a lower rate of depreciation or dividend to support investment in the factories.

The constant effort of the factory to make sufficient profit to protect the capital invested, and the constant effort of the farmer to make as high a profit as he can at the price the factory can afford to offer him, are the best safeguards to the carrying out of the national purpose of the Subsidy Act, which is essentially educational in character. Yet both capital and sugar beet growing, and consequently the purpose of the Act itself, are being prejudiced by statements, statistics and reports which have been circulated, some optimistic and some pessimistic, which can only be accepted with reserve by those who are actually engaged in the business because though made in good faith they are unreliable both in fact and inference. For these reasons the Committee of the British Sugar Beet Society have decided to take steps to conduct an enquiry into the results and progress of the sugar beet industry during the 1925 season for the information of the public.

So far as the results for that season are concerned these have not yet been ascertained, but one or two preliminary comments may be made. The average net sale price of sugar will approximate 26s. per cwt. as compared with 31s. per cwt. in 1924 showing a fall of 5s. per cwt. in the world prices, taking into account the quality of the factories' production in both years. The minimum price for beet has been raised to 54s. on a three years' contract, except that for a new factory last year the minimum has been 49s. These two factors have reduced substantially the expected income of the factories, though the farmer has been secured his price and the consumer has benefited through the fall in the world price of sugar.

The balance sheets of the factory companies to be included in the White Paper presented to Parliament later in the year will be encouraging to those who have undertaken the responsibility of carrying out the development of the industry and have counted the cost of experience, but may be disappointing to those who have been too ready to base their hopes upon rosy estimates of immediate results, and being misled by the enterprise shown in the building of new factories expect a galvanic rather than a gradually developing effect from the subsidy.

Average figures for the tons of sugar per acre have been compiled by the Hawaiian Experiment Station for the entire output from the Islands from 1895 to 1925. For the last five years the yields are: 4·71, 4·787, 4·646, 6·111 and 6·5, this last, for 1925, being an estimate only.

Examinations in Sugar Technology.

With the object of encouraging the attainment of a certain standard of proficiency in technological subjects, examinations are conducted annually by the City and Guilds of London Institute. Hitherto, the examinations in Sugar Manufacture have been taken by assistant chemists and assistant engineers and others employed by refiners, confectioners, and brewer's sugar manufacturers in the United Kingdom, and also by young men employed in various capacities on the cane plantation and in the cane sugar factory overseas. But it is now hoped that assistants engaged in the home beet sugar industry will also come forward for the Examinations.

The certificates granted to successful candidates have come to be regarded as a useful qualification for the young sugar technologist, and there has been keen competition for the medals (Bronze in Grade I and Silver in the Final) which are offered to candidates obtaining the highest number of marks in the examinations (provided that these are not teachers).

Attention may be directed to the fact that the Institute's examinations are held in India, and in many of the Overseas Dominions and in some Colonies, so that candidates residing in any part of the Empire can generally arrange to present themselves. Arrangements could probably be made through the Directors of Education for the Dominion or Colony for the Examinations to be held at centres in South Africa, Australia, the West Indies, Mauritius, India, and Hong-Kong.

In the past the Examinations have been held in two grades, known as Grade I and the Final Examination. But by an agreement recently concluded between the Board of Education and the Institute, only the Final examination will be held in future at centres in England and Wales, it being expected that examinations required of a lower standard will be conducted by the authorities of Technical schools. In Scotland, Ireland, and Overseas, however, the examinations will continue to be held in both grades.

Candidates in the United Kingdom should in general make arrangements for their accommodation for examination through the authorities of the technical school in the town in which they reside, and those desirous of entering at centres Overseas should communicate with the local Director of Education. If any candidates desirous of entering are unable to arrange for their accommodation for examination in this way, they should communicate a sufficient time in advance with the Superintendent, City and Guilds of London Institute, Department of Technology, Exhibition Road, South Kensington, London, S.W. 7, who will endeavour to suggest the name of the nearest school at which they may possibly be able to obtain accommodation.

The next Examination takes place in May, and the fee for Grade I is 3s., and for the Final examination 6s. All entries should be in the hands of Local Secretaries in the United Kingdom by March 9th ; but entries from candidates Overseas should be made before the end of the year. The Syllabus of the examinations has already been published.[1]

Mr. H. S. Dodds has been appointed Director of the recently instituted Experiment Station of the South African Sugar Association.[2] In the course of an article on the "Objects and Aims of a Sugar Experiment Station" he uses as an example that of the H. S. P. A., pointing out what it has achieved. Incidentally, he mentions that the running expenses of that Station are naturally very high for its extensive equipment and personnel, being equivalent to about £60,000 per annum, or nearly 2s. per ton of sugar produced, an expenditure which is by no means grudged.

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[1] *I.S.J.*, 1920, 439.

[2] *South African Sugar Journal*, 1926, 10, No. 1, 17.

Modern Steam Generation.

I.

By JOHN D. TROUP, M.I.Mech.E.

In view of the very rapid developments in steam generating plant during recent years, it is important that we understand what each particular section means in relation to the cost of steam, because it is the money value of the steam at the boiler stop valve which is the final test of efficiency.

WATER TUBE BOILERS.

These developments refer principally to the water-tube type of boiler; but it should be kept in mind that the principles involved apply equally to every type of boiler, and this is particularly true in the case of boiler-house control, which will be dealt with in a later article. The increasing importance of the water-tube boiler in the sugar industry is indicated by the rapid growth of beet sugar factories for which this short series of articles is primarily written. There is, however, a useful field for the water-tube boiler in the cane sugar factory, particularly when used in conjunction with the steam accumulator. This latter stores a reserve of steam to supply any sudden demand, and also enables the boilers to be operated at a constant load, which is not only the most efficient method of operation, but is also the simplest as regards regulation.

Another feature of the water-tube boiler of importance to the sugar industry is its adaptability for almost any class of fuel. It may be fitted with a furnace for burning bagasse or other bulky fuel, or it may be fitted for coal, oil, or gas.

MODERN BOILER EFFICIENCY.

The modern steam boiler is approaching an overall thermal efficiency of nearly 90 per cent., and we propose to consider briefly the reasons for it for being able to generate steam so efficiently. It is more correct to refer to boiler-house efficiency rather than to the boiler itself, because in a modern plant the actual boiler is but one of a number of co-ordinate units.

It is an instructive fact that the present high efficiency of the boiler-house has been brought about by careful attention to detail rather than by any revolutionary invention. The only item in a modern plant which may be termed revolutionary is the use of powdered fuel, but as there are stoker-fired plants operating with as high an efficiency as powdered-fuel plants it is clear that the former system cannot make any special claim for increased efficiency in the broad sense. What has happened is that the original principles of boiler-house practice have been retained, but they have been modified to make them comply more closely in actual practice with the theoretical reasons for higher efficiency.

The modern soot-blower, for example, is a typical case of this line of thought. Engineers have always known that a deposit of soot on any heating surface reduces the rate of heat transmission, yet we have been satisfied in the past to almost disregard this elementary fact. To-day, however, every modern power station has a set of soot blowers fitted to every boiler. These blowers consist of a series of steam nozzles permanently fixed so as to cover the whole of the heating surface where soot is liable to be deposited. At regular intervals these nozzles are momentarily operated, and by this method the heating surface is kept permanently clean.

FURNACE DESIGN AND STOKING.

The most important advance, however, relates to the improvements in furnace design. It may be said that in the average boiler plant the big economy is to be made at the furnace. If the fuel is consumed perfectly, with the minimum quantity of air, then high boiler efficiency results, provided there is sufficient clean heating surface to absorb the heat which is liberated by the furnace.

The tendency in modern furnace design is to increase the furnace volume to allow for complete combustion away from the boiler heating surface, and to provide every facility for the intimate mixing and correct proportioning of fuel and air supply. In these arrangements the stokers for modern water-tube boiler furnaces may be divided into two broad classes: namely, the travelling grate type, and the retort stoker. The former has been very generally adopted in England, and the retort type has been more favoured in America. In general, the travelling grate lends itself to most classes of coal, whereas the retort type is more suitable for the highly volatile coals.

The most outstanding improvement in the travelling grate stoker is the compartment arrangement below the fire grate. This arrangement consists of a series of separate compartments for directing the air through the fuel bed, and its function is to give control of the air pressure over different portions of the grate area. By this system it is possible to reduce the excess air to a minimum in a way which is impossible when the same pressure is maintained over the whole grate area. Coupled with this arrangement is generally provided the means for controlling the pressure both below and above the fuel bed; the system being known as balanced draught. For this purpose forced draught is delivered to the compartment chambers below the grate, and an induced draught system deals with the products of combustion above the fuel bed. This arrangement gives most perfect control of the combustion conditions and is one of the principal reasons for the high efficiencies with this type of stoker.

In the retort class of stokers a similar principle is used but in a modified form. In addition, special means are provided for admitting secondary air above the fuel bed to completely consume the volatile matter driven off from the distilled coal. This secondary air is admitted through the fire brick walls of the furnace by means of specially perforated fire bricks, which may line the four walls of the furnace if necessary, but they only extend a short distance above the fuel bed. In addition to supplying air for combustion these perforated bricks act as air preheaters and also tend to keep down the temperature of the brickwork and so prolong its life.

PRE-HEATING THE AIR SUPPLY.

An important development at this point is the increasing use of pre-heated air for the main supply to the furnace. The use of pre-heated air is an established aid to economy, particularly when low grade fuels are used. Pre-heated air increases the rapidity of combustion and increases the furnace temperature. The value of this function is two-fold. Firstly, low grade fuels are burned more efficiently, and secondly, the efficiency of the boiler is increased by the greater radiant effect from the furnace. On this latter point it is a well recognized fact that the greatest heat transfer from fuel to water in the boiler takes place in the few rows of tubes adjoining the furnace; so that as the furnace temperature is increased so the rate of heat absorption is increased at this point. This fact also explains why a lower exit temperature results from an increased furnace temperature.

To secure the most economic results from air pre-heating, the air must be supplied with heat from some waste source. This is generally provided for by utilizing the heat of the flue gases after they have passed the boiler heating surface. This matter brings up the question of the economizer, and at the present time there is much difference of opinion regarding the future of the economizer as a feed water heater. There can, however, be little doubt that the long established economizer has still an important lease of life before it, but in its present form where cast-iron pipes are used there is a limit to the pressure which can be applied, and in view of the high pressures which we are approaching the problem is one which is receiving the close attention of power engineers. There are methods by which the cast-iron economizer may be retained even when working at very high boiler pressures, such as by using two separate centrifugal feed pumps. In this case the economizer is fed in the usual way, but the economizer outlet is passed to a second pump which delivers direct to the boiler at the required pressure.

BOILER PRESSURES.

The question of boiler pressure resolves itself into a commercial proposition. From the thermal point of view it is a well recognized fact that the generating of steam at super-high pressures makes it possible to increase the overall thermal efficiency of the power plant, due principally to the greater expansion range available. Such high pressures, however, mean increased capital charges in more expensive plant, and it seems to be generally acknowledged at the present time that an average pressure round about 500 lbs. per sq. in. will give the most economic generating costs.

At the same time a great amount of research work is being carried out in different parts of the world, and we shall doubtless have to modify our views, perhaps in the very near future. In England we have had experimental boilers under steam at 3200 lbs. pressure, and on the Continent there are several boilers working at 1500 lbs. pressure. One of the most recent American power stations has adopted 600 lbs.; but the latest super-power station in Germany will operate at 495 lbs. per sq. in. This latter station was given very careful consideration with the object of considering super-high pressures, but after taking into consideration all the charges involved it was decided that the moderate pressure of 495 lbs. would be the most economic.

The future economic advance in steam power plant lies in increasing the boiler pressure, but there does not appear to be any possibility of considerably increasing temperatures in the near future. The present limits of existing materials are about 750°F., and beyond this figure the physical strength of materials rapidly falls off.

INCREASING THE FURNACE TEMPERATURE.

Efforts are being made to increase the furnace temperature, and in this direction considerable advance has been made. The most outstanding advance in this section of the boiler-house is the use of powdered fuel, which has already been adopted in a number of electric power stations in England and has been very largely adopted in America. The high temperatures attained with powdered fuel have brought forward new problems to solve, the principal one being to provide refractory furnace walls which will stand up to the high temperatures without melting. This difficulty has been overcome by the use of water-cooled walls combined with air cooling. In the latter case the wall is made hollow, and the circulated air enters the furnace in a heated state and is used as a secondary air supply for the powdered-fuel burners. The water-cooled walls consist of a wall of steel tubes, placed either vertically or horizontally with a slight rise. There are a number of different designs for these tubes, but generally they act as additional heating surface to the boiler, and there is even a tendency to actually build the boiler round the combustion chamber when powdered fuel is used.

How far the development of powdered fuel will extend is a very doubtful problem at the present time. The principle involved is ideal from the combustion point of view, but from the commercial point of view any increased economy has to be purchased at the price of increased capital charges for the extra plant involved. With the coming of large carbonization plants, where an ideal solid fuel would be available for stokers, engineers are called upon more and more to consider this problem from every possible angle.

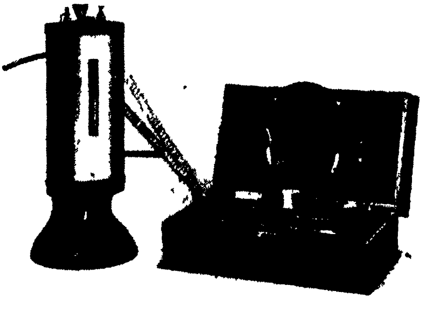
(*To be continued*)

Rapid Electrical Method of determining Ash.

In the usual method of determining the mineral matter or "ash," results accurate to about 3 per cent. are obtained, that is to say, if the amount of ash is 1·0 per cent., the result will be correct to within 0·003 per cent., whilst the process demands a certain amount of time and care. But by the electrical conductivity method, the accuracy is three times greater and the speed ten times more than in the gravimetric method. Determinations may be entrusted to untrained assistants, so simple is it.

The principle of the method is the measurement of the conductivity with a Wheatstone bridge and a telephone, the scale of the bridge being specially graduated from 0·5 to 3·0 per cent. so as to give the ash percentage directly.

Dr. LANGE,[1] of the Institut für Zuckerindustrie, Berlin, as the result of many tests made in 1910 established without any doubt the reliability of this method of ascertaining the mineral matter present in sugar products. He compiled a table with the aid of which it is possible to find the ash content of a given sample, provided its electrical conductivity is known; but this method of working did not find acceptance in many sugar laboratories owing to the inconvenience of the conductivity measuring apparatus, which rendered it unsuitable for routine operation.



Electrical Ash Apparatus.

An apparatus has now been devised, which, whilst still reliable, is very simple, and can be manipulated by any assistant after a very few instructions. This compact and convenient apparatus is shown in the illustration. It is an inexpensive apparatus that is likely to be found in every modern sugar factory and refinery laboratory alongside the polarimeter. Evidence of its reliability and convenience has recently been furnished by two articles, one by Dr. F. TÖDT[1] and the other by Dr. HARALD LUNDEN.[2]

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[1] *I.S.J.*, 1910, 423.

In determining the ash in raw sugars, massecuites, and molasses, the procedure is simply to pour a 5 per cent. solution into the reservoir through the small funnel shown in the illustration, some 30–40 c.c. being required for this. Switch *A* (not shown) is then turned to "On," then a slide moved to a position at which the buzzing sound in the telephone ceases, or, at least, is very faint, the reading on the scale at this position giving the result. A correction for the temperature, and one also for the resistance of the distilled water used should sometimes be applied, but the former correction once made may remain for some time, whilst the latter may generally be omitted entirely, excepting when working under conditions to attain special accuracy. Juices and syrups are similarly examined after suitable dilution so as to bring the ash content within the range already indicated. A second switch has two contacts, one for the indication on the scale of a range of ash from 3·0 to 0·9 ; and the other from 0·8 to 0·5 per cent.

This apparatus appears to be invaluable in sugar factory and refinery control. It cuts out the time and gas or alcohol consumed on ash determinations in the ordinary way, this saving soon repaying the cost of the electrical apparatus. Especially does it enable one to obtain a result in a fraction of the time ordinarily necessary.

Basic Dyes as Flocculating Agents for Approximate Quantitative Determination of Colloids in Sugar-House Liquors.

By M. S. BADOLLET and H. S. PAINE.

Carbohydrate Laboratory, Bureau of Chemistry, U.S. Department of Agriculture.

(*Continued from page 103*).

CONSTRUCTION OF A SIMPLE ULTRA-MICROSCOPE FOR CATAPHORESIS MEASUREMENTS.

In an attempt to simplify the dye test we have made numerous experiments for the purpose of finding some reliable means other than the ultra-microscope for determining when the colloidal particles are electrically neutralized. All these attempts have been unsuccessful. We expect to continue these efforts, but in the meantime it will be necessary to depend on the ultra-microscope.

The ultra-microscope may perhaps appear to some chemists to be a formidable instrument. If so, this is merely due to lack of familiarity with it. The construction and operation of this instrument can be so simplified that satisfactory ultra-microscopic observations, including cataphoresis measurements, may be obtained after a few trials. We have no hesitancy in stating that it is quite feasible to employ the ultra-microscope in sugar-factory control laboratories. As the application of the dye test here described depends at present on the use of this instrument, a practical and economical means of constructing a simple yet effective ultra-microscope and cataphoresis apparatus, which will put it within the reach of any chemist who is sufficiently interested, will be described in some detail. The total cost will vary from $30 to $70, depending on whether some of the parts are new or second-hand.

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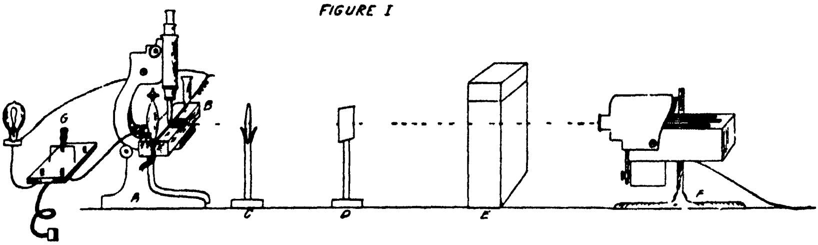
[1] *I.S J.*, 1925, 503.
[2] *I.S.J.*, 1925, 671

An ordinary microscope can be used by fitting it with a 7 mm. objective (air) and a 4× ocular. A new student microscope (without the objective, reflector, and ocular), costing $25, will serve the purpose. The objective and ocular should be carefully selected, as they are the most important parts of the microscope. The ocular and objective described will cost about $15.

The glass cell for cataphoresis can be made by anyone who is willing to give attention to details. A straight piece of capillary glass tube, 12 to 15 cm. long with an inside bore of about 2·5 mm., is placed in a groove cut in a block of wood to a depth equal to the outside diam. of the capillary tube. The tube is tightly held in place by sealing wax so that it will not move during the filing process. Near the centre of the glass tube a portion of the wood is cut away to permit a flat file (½ in. wide) to be drawn horizontally across the glass tube. The wooden block carrying the glass tube is tightly secured in a vise, and the tube is filed down to within 1·5 to 2·0 mm. of the inside bore. The wooden block is then turned through a right angle, a portion of the wood is cut away, and the glass tube is filed down at this point about the same distance as before so as to produce two plane surfaces at a right angle to each other. Both surfaces have about the same width as the file. The two surfaces should be checked by the aid of a small square during filing in order to make certain that they are at a right angle. After the two surfaces are properly filed the tube is removed from the wood block and a small thin cover glass is sealed over each of the filed areas by the aid of Canada balsam, thereby producing satisfactory optical surfaces.

FIGURE I



A MICROSCOPE
B CATAPHORESIS CELL MOUNTED ON WOOD BLOCK AND FASTENED TO MICROSCOPE
C LENS
D ADJUSTABLE SLIT
E BATTERY JAR WITH SATURATED SOLUTION OF ALUM
F ARC LIGHT
G COMMUTATOR AND LAMP

The two glass side reservoirs with platinum electrodes are fused to the ends of the capillary tube so that one of the optical surfaces of the tube will face the arc light and the other the objective of the microscope. The electrodes are prepared by sealing in the wall of each glass reservoir a platinum wire lead, to which a piece of platinum foil is annealed. If the electrodes are not close enough to the capillary tube they can be pushed over by a wire. The two reservoirs differ in height. The open one is 3 in. high and the one with the two stopcocks is 2 ins. high (*cf.* Fig. 1). This arrangement permits the liquid examined to flow through the capillary tube and fill the closed reservoir to overflowing before closing the top stopcock. The capillary tube with attached reservoirs is now mounted with sealing wax in a groove in a small block of wood prepared in the same manner as the wood block which held the tube during filing. The block is then clamped to the stage of the microscope directly beneath the objective.

An arc lamp of any type that has a collecting lens and produces an intense beam of light can be used. The arc is operated only during observations. An arc lamp can be easily improvised. Next to the arc is placed a battery jar of rectangular cross section containing a saturated solution of alum to absorb heat from the arc. Next in order is an adjustable slit that can be made of a piece of tin about 3 in. square, mounted on the end of a stick, the other end of which is nailed to a baseboard. The tin is punctured in the centre by a nail, and the edge of the opening is filed smooth. Pieces of black paper are pasted across the hole so as to leave a narrow slit along its horizontal diameter. Between the adjustable slit and the microscope is placed a lens with a focal length of approximately 10 cm. The lens can be mounted on a wooden block cut in the shape of a Y and nailed to a baseboard.

The microscope, lens, adjustable slit, battery jar, and arc lamp are aligned in order on a table. The arc lamp, adjustable slit, and lens are moved backward and forward until positions are found such that a strong beam of light is focussed through the optical surface of the capillary tube facing the arc.

The electrodes are connected with the lighting circuit or any other suitable source of direct current in such a way that the current passes first through a commutator and then through a 50-watt lamp in series. The commutator may consist of a two-blade double-throw switch with the connecting wires crossed so as to permit reversal of the current. In our work the potential difference between the electrodes was 210 volts. In case the electric circuit available is of lower potential difference and the movement of the colloidal particles toward the electrode is too slow, the length of the capillary tube should be diminished to reduce the distance between the electrodes.

When the apparatus is adjusted the procedure is as follows : Fill the cataphoresis cell to overflowing with the liquid to be examined and close the stopcocks. Turn on the arc light and adjust the objective of the microscope until the surface of the capillary cell is visible. Then slowly lower the objective until a point is reached where the colloidal particles do not show progressive movement toward either electrode. Lock the instrument at this point. The electric current should not be allowed to pass between the electrodes while this adjustment is being made. If the radius of the capillary is known, the zero progressive movement of the particles may be found by lowering the objective to a distance of $0{\cdot}293 \times r$ ($r =$ radius) from the top of the capillary. If the current is now allowed to pass between the electrodes the colloidal particles will move toward one of the electrodes and will reverse their direction when the current is reversed. By ascertaining which of the electrodes is the cathode and which is the anode the sign of the charge on the colloidal particles can be readily determined, as the particles move toward the electrode of opposite sign. The stopcocks must be kept well greased, and they must be tightly closed when making an observation. A leak at the stopcock causes minute currents in the liquid that partially or wholly conceal the electric migration of the colloidal particles. Reversing the flow of current through the cell every few seconds during an observation minimizes the lag in reversal of movement of the colloidal particles due to polarization of the electrode.

The following prices from a standard catalogue listing microscopes and accessories may serve as a guide in buying new parts :—

	$
Student microscope (without objective and ocular) .. .. (Includes body tube of standard size with draw tube, arm, base, rack, and pinion for focussing adjustments.)	25.00
Objective, 7 mm.	10 00
Ocular, 4 ×	4.50
Lens, unmounted (about 7.5 cm. diam., focal length about 10 cm.) ..	3.00
Arc lamp	25.00
Carbons, 2 doz..	1.44
	$68.94

By purchasing used material, this expense can easily be reduced to less than $30.

For the purpose of determining when the colloidal particles in the liquid examined have been electrically neutralized, it is necessary merely to ascertain when they fail to show progressive movement towards either electrode. Measurement of the speed of migration before neutralization is not required. This progressive movement towards an electrode should not be confused with the irregular Brownian movement of the colloidal particles which continues after neutralization.

In case it is desired to measure the speed of electrical migration of the particles (as an indication of colloid stability), the microscope should be provided with an eye-piece micrometer. This can be calibrated against a stage micrometer, on which it should cover a range of about 0·5 mm. The potential difference in volts between the two electrodes must also be determined in order that the potential gradient or drop in potential per linear unit between the electrodes may be calculated. Detailed information on the technique of measuring the speed of cataphoresis or electrical transfer of colloidal particles between electrodes has been published by various investigators.[1]

In the investigation described in this article a Zsigmondy-Siedentopf ultramicroscope manufactured by **ZEISS** was used. We have also constructed an ultra-microscope and cataphoresis apparatus from the materials and parts just mentioned. This apparatus was used with entire satisfaction by a member of this laboratory in a beet sugar factory laboratory during an investigation conducted in the 1925 campaign.

SUMMARY.

Of a number of dyes investigated, night blue has been selected as the most suitable reagent for the approximate quantitative estimation of colloids. This method of estimation is based on the principle of electrical neutralization. It is well suited to sugar factory and refinery control and a test can be made in 10 minutes.

Data have been presented illustrating the application of the method to cane juice, raw cane sugar, and beet molasses. Its practical value is shown by the correlation between the data obtained and certain other measurements and observations.

The theory of the method has been discussed and its limitations have been indicated. These limitations do not interfere with the usual requirements of factory control work.

The use of an ultramicroscope and cataphoresis apparatus, which may be easily constructed at a cost of $70 to $30, or even less, is entirely practicable in the control laboratory.

The dye test may be used to advantage in other industries in which colloids play an important part.

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[1] SVEDBERG, *Nova Acta Reg Soc Sci. Upsaliensis*, Series 4. 2, 149 (1907); ELLIS, *Ztschr. physik Chem.* (1911) 78, 321; POWIS. *Ztschr. physik. Chem.* (1914), 89, 91, COTTON and MOUTON, "Les Ultra-microscopes et les Objets Ultra-microscopiques, Paris," (1916).

Recent Work in Sugar Cane Agriculture.

HISTOLOGY AND CYTOLOGY OF SUGAR CANE MOSAIC. *Melville T. Cook. Journal of the Department of Agriculture in Porto Rico. IX, 1, January, 1925.*[1]

In this paper the author records a careful examination of the tissues of diseased and healthy plants as regards mosaic; and it may be taken as the author's latest contribution to the "protozoan theory" advanced by **MATZ** and **KUNKEL**, and discussed by **IANOWSKI**, **PALM**, and other workers. The first part consists of a "catalogue raisonné" of all previous writers on mosaic who have approached the subject at all along this line, and especially the aberrant cell structure of mosaic tissues. This summary of some score of papers is likely to be extremely useful for ready reference, but it will be unnecessary to do more than merely mention it here, because the bulk of the papers deal with tobacco, tomato and so on, and thus with diseases to a certain extent removed from that of the sugar cane. And this difference is undoubtedly rendered greater by the fact that the tissues of the tobacco and tomato, which are dicotyledons, bear little resemblance to those of maize and sugar cane, which are monocotyledons of the grass tribe. The method adopted by the author has been to compare the tissues in the leaves, stems, and roots of healthy and mosaic infested plants; in the leaves, indeed, by the study of the light-coloured and dark-green parts of the same leaf, the chief desideratum being to examine the contrasted organs at exactly the same stage of development. In the early stages of the investigation it was found that no traces of differences could be found in the roots, and their study was therefore not proceeded with.

The chief interest is naturally shown in the leaf structure, and for ready reference an excellent figure is given of the transverse section of an average cane leaf as seen under the microscope; this is used as a sort of map on which to mark the particular area, tissue, of cell dealt with. At the same time, in few lines the main forms of tissue in the complicated anatomy of the cane leaf are described. After certain general remarks, the author then concentrates upon his study of "intracellular bodies," somewhat hazy and of no particular form, but which to some observers have great significance, if indeed there are not the actual causative organisms of the disease. Later, he proceeds to note down observations as to the effect of the disease upon the cell nuclei and chlorophyll grains, and the presence of lesions or tears in the affected parenchyma. The paper is further illustrated by some 53 drawings of microscopic details and four photographs of the transverse sections of healthy and diseased leaves, stained so as to show up the nuclei and chlorophyll grains.

The effects of mosaic disease upon the tissues are, as might be expected from the external appearances, much more conspicuous on young or actively growing parts of the plant than on older portions. Thus, in a sugar cane plant with 20 leaves, certain of the symptoms well seen in the newly expanding leaves may have practically disappeared in the oldest one. In the youngest leaves the light areas are much more conspicuous and, correspondingly, microscopic examination shows that there are far fewer and also smaller chlorophyll grains. The light areas of the leaf are always slightly thinner than the healthy green ones, but the sugar cane leaves show far less divergence in this respect than do those of the tomato and tobacco; this is a direct consequence of the absence of the

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[1] This date by no means indicates that of the appearance of this paper—a feature often met with in publications in the tropics. A note records the fact that it was "received for publication in July, 1925"; and, of course, it would take some time for printing (a large number of figures) and issuing. It is especially desirable with regard to scientific publications, where priority is important, that errors of this kind should be avoided.

"palisade tissue" in these monocotyledons, a tissue the cells of which become much shorter in mosaic leaves.

The intracellular bodies were found, but only after careful search, without which the author thinks that he probably would not have seen them. This perhaps does not augur well for their being active living organisms. They were neither abundant nor conspicuous and were dense or nebulous; but were never found either in the roots of diseased plants or in any healthy tissue. Their structure appeared to be protoplasmic, and they were usually although not universally seen to be in contact with the nuclei. They were finely granular, irregular in outline and occasionally provided with a delicate covering membrane. Except in rare cases they were certainly not amoeboid, and no trace was found of any nuclear structure in them, both of which conditions would be expected in bodies of protozoan nature.[1]

The nuclei appear to be strongly affected in diseased tissue, being much enlarged and irregular in outline, especially in the white areas of the leaf; but it is somewhat remarkable that, in extreme cases, no intracellular bodies are found attached to them. Such enlargements have been found by observers in various fungal and bacterial diseases, even when the causative agent is several cells away, suggesting the action of some enzyme. An interesting series of figures representing the outlines of the nuclei in successive leaves of one plant, from the oldest to the youngest, is given in illustration of this. It is seen that, while in the older leaves the nuclei are more or less ordinary, they are more and more abnormal both in size and shape as the leaves are younger.

The study of the chlorophyll grains or chloroplasts is of special interest, for it is in their behaviour that the external markings of the disease have their origin. While the nuclei are specially enlarged in the youngest leaves, the chloroplasts are extremely small there, and gradually increase in size until in the oldest leaves they are practically normal. The contrast in the behaviour of these two cell constituents under diseased conditions is illustrated by a series of parallel outlines of nuclei and chloroplasts from the youngest to the oldest leaf. It is customary to speak of the disintegration of the chloroplasts as a direct effect of the disease, but COOK regards this as incorrect, as those found in the diseased areas are simply few and small. He considers, then, that the effect of the disease is to check their development; and, as the leaves are exposed to the light, this effect gradually wears off, and they ultimately grow to practically normal proportions. This is of course in keeping with the ease with which the diseased condition is detected in the youngest leaves and the difficulty experienced later on.

Lesions or internal cavities in the tissues are considered by KUNKEL as a sympton of mosaic. The author speaks of them as due to the collapse of the parenchyma over small isolated areas, by the dissolving of their walls. Such lesions are commonly met with in other diseases.

Leaving apart the critical study of the character of the intracellular bodies, with a wealth of drawings which are of special use, perhaps the most interesting suggestion in this paper is the inhibiting action of the mosaic disease upon the development of chlorophyll grains, and the proof that, with access to light, this gradually wears off. This observation and interpretation is the more readily acceptable because it agrees so closely with the external phenomena.

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[1] The appearance described would, to an ordinary student of plant histology, indicate, rather than independent organisms, protoplasmic aggregations, possibly disintegrating, near the cell nucleus, which is the centre and controller of metabolic activity in the cell itself. When the nuclei divide and their segments become intermingled with the general cell protoplasm, these "bodies" disappear entirely, suggesting again that they are essentially products of the cell structure and not foreign organisms. One writer quoted by the author, SMITH, working on potato in 1924, found the intracellular bodies and regarded them as "degenerate products of the host cells."—C.A.B.

The following is the author's summary of his results: (1) The symptoms of mosaic are more conspicuous on actively growing than on slow growing plants; and on the new than on the old leaves of a diseased plant. (2) The light areas of a diseased leaf are slightly thinner than the green areas. (3) The green areas correspond in every way to the leaves from healthy plants of the same age and variety. (4) The cells in the light area of a diseased leaf are slightly less in size than those in the green areas. (5) Intracellular bodies were difficult to find but correspond well with those reported by KUNKEL. (6) The host nuclei were usually very much enlarged in the diseased tissues, especially in the tissues of the leaves. They were frequently very irregular inform and it was very difficult to find intracellular bodies associated with them. The chloroplasts were smaller and fewer in number in the mosaic than in the healthy leaves. (8) The internal cavities in both stems and leaves start with a disintegration of the cell walls.

Annual Report of the Bureau of Sugar Experiment Stations, Queensland, 1924-1925. *H. T. Easterby*, Director.

This lengthy report has as usual much of interest, and is so packed with information that it is perfectly impossible to do it justice in a short article: it extends to about 80 folio pages. The author has made it a custom periodically to supply various details as to the progress made in the industry for a number of years; and now that Queensland is becoming one of the chief cane sugar producers of the world it may be of interest to review some of the lines of progress. One of the most striking among these is the rapidity of the increase in the acreage under cane and the amount of sugar produced per acre. A table is presented as regards this for the past 26 years, which practically coincides with the period of activity of the Bureau. Without repeating this long table, we can perhaps obtain the best idea by averaging the figures for the first and last five years periods, as follows:—

	Acres cultivated.	Acres crushed.	Tons of Cane.	Tons of Sugar.
1899-1903	105,719 ..	69,945 ..	932,137 ..	101,031
1920-1924	204,543 ..	113,867 ..	2,202,402 ..	283,139

It will at once occur to anyone reading these figures that, while the acreage crushed at the commencement of the period had not doubled at its conclusion, the sugar produced had during the same interval increased by nearly three times. This is a result of which the Bureau may well be proud. Great changes had of course taken place in the structure of the industry: there was the change from Kanaka to white labour which was so confidently prophesied to bring about the ruin of the factories: the large estates were split up into a vast number of small plots, bringing into being a cane-farming population, independent of the mills: the latter were wholly remodelled and all small uneconomic ones were scrapped: the kinds of cane grown were completely altered for the better; and, last but not least, the Government intervened, although not always successfully. But a great deal of the most various scientific work was done by the Bureau, especially perhaps in the fighting of the pests in the fields, and a mass of advice was distributed to the farmers for their help and guidance.

Another table furnishes additional data which are also significant of the material advance in the work of sugar production, and these data are ready arranged for us, the averages alone being given here:—

	First ten years.	Second ten years.	Last six years.
Tons of cane per acre	14·76	17·37	16·25
Tons of sugar per acre	1·60 . .	1·99	2·08
Tons of cane to one of sugar	9·20	8·68	7·79

In spite of the falling off in tonnage during the last six years, a direct consequence of and commentary on the series of severe droughts encountered during this period, the actual amount of sugar per acre increased (presumably partly due to the added density of the juice and its greater purity caused by this drought).

Another point, to which attention has been repeatedly drawn in this Journal, is the steady movement of the industry, as a whole, from the dry semi-tropical south to the humid and eminently tropical north of the sugar belt. The three sections in which cane growing is concentrated are, each of them, served by its own experimental station: Bundaberg in the south with poor rain and occasional frosts, Mackay in the centre with intermediate conditions, and Cairns in the north with perhaps too much rain coupled with high temperature. It is in the latter district that development has been rapid, as is seen by the following figures:—

In the two southern tracts there were, in 1910, 42 mills producing 153,621 tons of sugar, in 1925, 27 mills with 269,080 tons of sugar (estimated). In the northern tract the figures were, in 1910, 7 mills and 57,135 tons of sugar and, in 1925, 10 mills and 215,550 tons of sugar (estimated).

And these figures lead us to the astonishing conclusion that, after Queensland reached its record crop of over 400,000 tons of sugar in 1924, a further leap has been made and the estimated yield in 1925 is placed at 484,000. It must not however be imagined that all of this increase is due to a specially great effort in these two years: it is to our mind merely an indication of the steady work of the last five or even ten years, the results of which were inhibited from showing themselves by the almost chronic adverseness of the climatic conditions. The change to better growing and maturing weather which has characterized the past two seasons has released the bonds, and enabled the industry to show what improvements and extensions have been made in consolidating itself.

But, when we come to a contemplation of the actual work of cane growing, it is only too evident that things are not as they should be. This is partly due to the fact that the cane is grown by a class of men with little capital, but also often because of little actual knowledge of the requirements of the sugar cane plant. The number of cane farmers has greatly increased in the past five or six years. In 1920 there were about 4000, while at present there are reported to be over 6000. Every year the Director and his assistants have thus a wider circle of cane growers who can only be reached by touring the country: probably by far the most important duty of the staff. It is the custom of the field assistants to send in a report on each farm visited, and the contents of these reports may be gauged by the questionnaire prepared for them by the Director.[1] Year by year there has been a steady increase in the number of reports sent in; and, by referring to recent annual reports, we see that these have increased from 1391 in 1918-9 to 4133 in 1924-5. Among the details drawn from these reports, the Director gives each year, besides the number of farms visited, the number of farmers using lime, green manuring and artificials, and these figures are increasing year by year. But this is not altogether satisfactory: what would give a truer indication of improvement would be the proportion of farmers adopting these somewhat elementary practices. We have accordingly struck averages for the past six years, and find that there is little variation in the annual percentages: in the use of artificials, only one in five farmers of those visited uses them, and this is about the proportion six years ago: there is thus no real increase in the practice. Taking this as a fair gauge of the character of the cultivation generally, it is obvious that the area under cane in Queensland is not producing anything like what it should do. There is in fact little doubt that in the industry as a whole the farmer, as the Director points out, is getting his cane by cultivating too large an area rather than by cultivating it properly. This we regard as the key to the whole situation. If the farmers concentrated on smaller areas they should be able to obtain the same quantity of canes for the mills, and of a better character: needless to say with a great saving in their impossible labour bill. And that this is impossible can at once be seen by the price given for sugar consumed within the Commonwealth, as compared with that which is to be given for sugar exported.[1]

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[1] A full copy of this questionnaire is given in *I.S.J.*, 1920, 221-2.

One other point of great import is strongly commented on by the Director, and that is the lengthening of the crushing season. The natural season for crushing the sugar cane the world over is when the active growth slows down in the dry cold period: fortunately in most parts of the tropics the rains occur mainly in the summer, especially in regions of periodic rains. But the great masses of cane grown in the past two years have resulted in the milling season being extended, after this cool dry period, into the hot rainy season. Without more exact knowledge of the local possibilities one cannot suggest a remedy, but the Director appears to consider that it can be obtained, and it certainly needs attention. With the annual increase in the amount of sugar which has to find its level in the world's markets, it is obvious that, for the wave of prosperity which seems to be passing over the industry not to have a serious backwash, a great deal of fundamental work is opening up for the Sugar Bureau, and it is sincerely to be hoped that its warnings will be attended to in time.

C. A. B.

Porto Rico.

Sugar Production for Seven Years.

(After J. R SOLES, San Juan.)

District	Number of Centrals.	PRODUCTION (METRIC TONS)			
		1918-19	1919-20	1920-21	1921-22
Norte	11	100,241	135,785	136,604	117,268
Sur	10	167,777	180,529	190,140	157,518
Oriental	8	82,185	100,451	99,205	84,377
Occidental	4	30,325	32,569	25,886	16,942
Interior	8	25,605	36,553	39,279	29,831
Grand Total	41	406,133	485,887	491,114	405,936

District.	Number of Centrals.	PRODUCTION (METRIC TONS)			(Met. Tons) Estimate.
		1922-23	1923-24	1924-25	1925-26
Norte	11	100,217	118,999	174,572	161,000
Sur	10	150,351	167,194	266,020	245,150
Oriental	8	79,963	99,201	131,403	122,625
Occidental	4	21,520	26,903	34,917	39,012
Interior	8	27,020	35,676	53,620	49,900
Grand Total	41	379,071	447,973	660,532	617,687*

Among new companies recently registered in the United Kingdom are: Carbon Research Syndicate, Ltd., manufacturers of and dealers in chemicals and chemical substances; nominal capital, £500 in £1 shares, registered in Jersey.

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* Equal to 551,506 long tons.

[1] *I.S.J.*, 1926, 69.

Fire Protection for Sugar Mills.[1]

By BERNARD FROISETH.

For a great many years the fire insurance companies did not consider that it would be better business to encourage the assured to improve their property from a fire insurance standpoint, believing that their business was merely to collect premiums and distribute losses. However, the companies in recent years have changed their attitude in this regard and now encourage the assured to practise fire prevention and protection, and they maintain many organizations which make fire prevention inspections.

Sugar mills should be safeguarded in every possible way against loss by fire, and the insurance companies recognize effective protection afforded a plant by substantial credits in the rate of insurance.

Attention is called to the fact that a sugar mill may be fully covered by insurance at the time of a fire, but that the owners might suffer severe consequential losses over and above the amount of insurance that they might collect. Such uninsured losses might occur from interruption of business and also from their inability to grind the crop of growing cane.

The principal fire hazards of a sugar mill are in the boiler room, electrical installation, and steam pipes, and these hazards will be commented on briefly before going into the matter of fire protection and prevention.

Boiler rooms.—The hazards of boiler installation come chiefly from explosion, from overheating of chimneys or stacks, with consequent setting fire to buildings; from ignition of floors, partitions, or other woodwork near by; and in connexion with fuels such as oil, coal, wood, bagasse and sweepings.

The greatest safety for any boiler installation is secured with a detached building, preferably incombustible. When it adjoins a sugar mill or warehouse, the boiler room should preferably be of fire-resistive construction, cut off with standard fire doors. If boilers are located in the mill' building, the floor construction over them should be incombustible, there should be ample clearance, and neither combustible finish floor nor combustible storage kept immediately over the boiler room, if there is the least possibility of transmitted heat producing a dangerous temperature. Concrete or tile construction holds and transmits long-continued heat to a dangerous degree.

Roughly speaking, any boiler or heating device so installed that it heats surrounding wood or other inflammable material to a temperature of 150° F., or slightly more, and for a considerable period of time, is likely to cause a fire. It is astonishing to observe under what apparently safe conditions it is possible for long continued low temperatures to cause a fire.

The hazard from bagasse in the boiler room cannot be overestimated. The recent fire in the mill of the Oahu Sugar Company, Hawaii, clearly demonstrated the fact that bagasse is subject to spontaneous combustion. The bagasse and cane dust which settle on frame, walls and roof of sections of a mill building are very combustible and constitute a menace to a plant if it is allowed to accumulate.

Electrical fire causes.—The fundamental causes of electrical fires are arcs and overheating. The separation of conductors or parts of different potential and the design of equipment to carry safely ordinary loads and even overloads, coupled with automatic protection (fuses or circuit breakers) to open circuits if overloads become severe enough to become dangerous, enter into the design of all electrical equipment. This should be actively borne in mind in considering electrical fire hazards.

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[1] Presented at Fourth Annual Meeting of Association of Hawaiian Sugar Technologists, Honolulu, October 26, 1925.

Generators have substantially the same fire hazards as motors. Disastrous fires have occurred because crane blocks have come in contact with generator connexions. Switchboards of the modern type contain little fire hazard. Switches are dangerous largely because of poor contacts and connexions causing arcs or heating, and because, if exposed and struck by metal, violent short circuits may result.

Oil switches have proved to be a very definite fire cause. The hazard lies chiefly in the oil switch rupturing under heavy overload, as from short circuits on lines, burning oil being scattered and fire spread thereby. Not only have incombustible buildings been destroyed by such fires, but the life hazard has also proved to be a considerable one. Transformers containing oil for insulating and cooling purposes have also caused some exceedingly severe fires in industrial plants.

Fuses and circuit breakers are the safety valves of electrical systems. They are often omitted and frequently abused. Circuit breakers are commonly set unnecessarily high. Fuses are too large, cartridge fuses are refilled or bridged with fuse wire of too high carrying capacity, and occasionally copper wire will be found in place of fuses. For reasons of safety, economy and convenience, cartridge fuses properly designed should be used generally.

Temporary wiring, even if admittedly dangerous in the first place, very frequently becomes permanent. Even temporary wiring should be safely installed and all dead wiring promptly removed so that it will not be connected up after disuse has permitted deterioration.

"*Flash fires.*"—In the U.S.A. they have had numerous "flash fires" in sugar warehouses, caused by fibrous matter from sugar bags spreading itself on the floor—fire being occasioned by friction from the iron wheels of trucks and also from nails in the shoes of workmen. This hazard is much greater where the floor is concrete than on a wood floor.

Fire prevention.—Fire prevention is fire protection. Fire prevention is a very important matter, and the old adage might be changed to read "An ounce of fire prevention is worth more than several hose streams." It is easier to guard against a fire than to extinguish it after it has once been started. Good housekeeping should be emphasized; also careful guarding of hazardous operations. If fires can be prevented from being started, naturally the fire extinguishing equipment will not be called upon.

Fire protection.—It must be borne in mind that private fire protection at the best is first aid only. A private fire department cannot be expected to cope with a serious fire; for that reason all equipment must be kept in first-class condition in order to extinguish a fire at the beginning or prevent its spreading. The protection system should be inspected regularly, beginning at the water supply and following through the supply mains, hydrants and hose, making certain that everything is as it should be. All equipment should be examined and tested. Inside protection should be carefully gone over, not only to see that it is in perfect working condition, but it should be readily accessible and distributed according to the type that is most effective for extinguishing the kind of fire that may occur.

Outside fire protection.—Next in importance to an adequate water supply is an adequate distributing system. Such a system should be able :—

1st.—To deliver the desired amount of water at all important points without serious pipe friction. Keeping within a 25 lb. friction allowance is good practice.

2nd.—To permit concentrating all available water at important points with hose lines not over 150 ft. long. This usually calls for a fairly complete covering of the plant with the piping system.

It is vitally important that absolute separation be secured as far as fire and domestic piping is concerned, for the following reasons:—

(*A*) Domestic piping is frequently not so heavy or so well installed as fire mains, with subsequent breaks or blowouts when fire pressure is applied.

(*B*) Domestic connexions in buildings may be broken by fire and the system bled. Safely located control valves are seldom installed in combined systems. Also, the amount of high pressure water available is limited, as a rule.

(*C*) Changes in domestic piping may interrupt fire service frequently in the course of a year.

A liberal number of hydrants makes for economy and efficiency. A hydrant costs only two to three times as much as a length of hose, and the depreciation on hydrants is far less than on hose. Friction in long lines of hose is a serious matter while friction in a hydrant is almost nothing by contrast. Sufficient hydrants should be installed so that 150 ft. of hose, from the two nearest hydrants, will reach any fire in the central section of a plant.

If located too close to buildings, it may not be possible to reach the hydrants at the time of a fire, or they may have to be abandoned with the possibility of crippling the entire water system. Hydrants should not be closer than 50 ft. from buildings of ordinary height. They should be so located that they will be out of roadways, railroad tracks, and, if possible, out of line of future buildings.

Interior fire extinguishing apparatus.—Valuable fire protection may be secured from inside standpipes and hose, which also have value for protection against exposure as well as for interior fires.

Four things are necessary: A supply of water; installation of pipes, valves and hose; constant maintenance; and persons available who have the knowledge and inclination to make prompt use of such facilities.

Fire plugs for inside service should be at least 1½ in. inside diameter and so distributed throughout the building that, with 50 ft. of hose at fire plugs, at least one good hose stream can be directed on all parts of the interior of the building.

Chemical extinguishers are required for inside protection, both with and without a standpipe system. These are thoroughly standardized throughout the United States, and furnish in incipient fires a small jet of water under high pressure, reaching a point of from 30 to 40 ft. from the operator, and lasting, if continued in use, for about one minute. The rules of the fire marshal of Hawaii require one of these extinguishers for each 2500 ft. of floor area. Extinguishers should be hung from hooks with tops about 5 ft. from floor level. They are readily upset, and partly or entirely discharge if resting on floors or shelves. Annual discharging, cleaning and recharging is recommended, partly to insure the operation of the extinguishers and partly to give employees and others an opportunity to see them used.

The watchman.—The watchman should be the most important link in a private fire prevention and protective system, but usually is not, for the reason that he has not the proper qualifications. While a sugar mill is in operation, the premises are in charge of men of intelligence and ability. When a mill is not in operation, and principally at night, when the most fires occur, the premises are left in charge of the watchman, who therefore should be a man physically and mentally sound, alert, intelligent, and of the best morals. He should possess good sight, hearing and a keen sense of smell, all of which are valuable in the detection of fire. He should not be chosen for the job until he has been employed in other positions about the premises long enough to become acquainted. He must be familiar with the location and operation of the fire equipment, must be able to recognize fire hazards and should be given to understand that his is a position of responsibility that calls for something more than a clock puncher. A clock record that shows perfect punctuality shows that the watchman thinks his only duty is to punch the clock at the proper time.

Changes in the Composition of Frozen Beets.[1]

By Dr. J. VONDRAK.

Investigation of the changes in the composition of the harvested beet certainly belongs to the important problems with which the sugar factory chemist is concerned. This question has become more important in recent times, since, in consequence of the greater quantities of roots to be sliced, it is no longer possible to give so much attention to its storage as formerly, when deliveries were carefully siloed.

In the present method of accumulating in heaps, the roots are exposed to the danger of easily heating up in warm weather, deterioration thus easily resulting. A low temperature naturally constitutes the best protection; but even at freezing point the danger of decomposition is not precluded. On the contrary, with thawing a dangerous condition may set in, the cell-walls being frequently ruptured by the frost, so that the juice soon becomes exposed to the direct action of bacterial infection, especially when subsequently the temperature increases.

So long, therefore, as the beet remains in the frozen state, its sugar content is in no serious danger, as Schonebaum's recently published results have confirmed.[2] Nevertheless, it is impossible to exclude the action of invertase, which according to my experiments is still active even at specially low temperatures, as — 12° C. The presence of invertase in the beet was proved by STOKLASA.[3] Normally, the sucrose in sound roots does not undergo inversion, and so it can be accepted that this enzyme is enclosed in special cells, or that its action is impeded by other substances.

But the case is different with frozen roots, in which after rupture of the cell walls the contents can easily mix. Therefore, the question is to establish whether, and if so to what extent, the influence of invertase may make itself felt in frozen roots.

Two undamaged beets sent us by the Dobrovic Experiment Station were cut into eight slices lengthwise, and eight samples were so prepared, that in each portions of both roots were present. Two of the eight samples were submitted to analysis, a sucrose content of 19·29 per cent., and an invert sugar content of 0·13 per cent., being found.

Then the single samples were introduced into wide stoppered cylinders, four of these being immediately placed in the chest of an ice-machine in which a salt solution had previously been cooled to — 12° C. Two other samples were placed in a water-bath at 65° C. until a thermometer inserted through an opening indicated

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[1] Translated from *Zeitsch. Zuckerind. Czecho-Slov.*, 1926, **50**, 130-132.
[2] *Tijdschrift*, 1923, **24**, 112. [3] *Zeitsch. Zuckerind. Bohm.*, 1904-05, 29.

60° C., the cylinders being removed after 15 mins., cooled under running water and afterwards submitted to freezing.

Immediately after freezing had taken place, one of the samples which had been directly submitted to this effect was analysed. Both parts were bored through by means of the Herles' press while still in the frozen state, and the pulp after thawing submitted to analysis by the cold aqueous digestion method with the addition of neutral and also of basic lead acetate, the filtrate from the neutral acetate being used for the estimation of the invert sugar content. Results of Experiments I and II are summarized in Table I.

Table I.

	(*a*) DIRECTLY FROZEN BEETS.			(*b*) THAWED AND AGAIN FROZEN ROOTS.			(*c*) HEATED ROOTS.		
EXPERIMENT I.	Sugar.	Invert Sugar.	Invert Sugar for a Sugar content of 20%	Sugar.	Invert Sugar.	Invert Sugar for a Sugar content of 20%	Sugar.	Invert Sugar.	Invert Sugar for a Sugar content of 20%
At the beginning of the experiment..	20·4	0·13	0·13	22·65	0·15	0·13	20·05	0 14	0·14
After 27 days	22·7	0 17	0 15	25·4	0·29	0·23	20·55	0·18	0·17
EXPERIMENT II.									
At the beginning of the experiment..	19·05	0·14	0·15	18·9	0·11	0·12	18·95	0·17	0·18
After 46 days	18·85	0·21	0·22	18·5	0 29	0·31	18·95	0·19	0·20

In the same manner the second sample was analysed after being kept for 27 days in the ice chest at a temperature varying between —5 and —12°C. Although the colour of the frozen roots was normal even after a month, yet from the analysis of the sample it can be concluded that during the course of the experiment a definite though slight increase in the invert sugar content had occurred, this amounting to 0·13 to 0·15 per cent. for a sugar content of 20 per cent.

The two other frozen samples were used for ascertaining the effect of thawing and repeated freezing, the partial mixing of the cell contents being thus made possible. Thus, after freezing the two samples concerned were allowed to stand in a room for 24 hours at about 5°C., and afterwards submitted to freezing. One portion immediately after having been repeatedly frozen was analysed, whilst the other was examined only after keeping for 25 days in the ice chest. This time, therefore, the difference in the invert sugar content is more considerable than before (as can be seen from the analytical results, *I b*), this well demonstrating the effect of the mutual permeation of the juice from the different organs of the beetroots.

But at the conclusion of this test, the colour of the beet was finally blueish-grey, certainly abnormal. The experiment made with the beet portions which had been heated to 60° C. indicated that this temperature had not sufficed for the destruction of the invertase, since from the moment of freezing until the end of the experiment (that is after 27 days) an increase in the invert sugar of 0·03 per cent. had occurred (example *I c*).

In order to provide a more conclusive proof, a further series of tests was instituted in which the duration was extended to 46 days. On analysis, the control samples gave the following figures :—Sugar, by cold aqueous digestion, 18·10 ; invert sugar content, 0·14 per cent. Otherwise, the order of the tests was as the first series excepting only that the thawed samples were allowed to stand at a temperature of 5°C. twice as long, namely 48 hours, and for heating a temperature of 65°C., that is 5°C. higher, was chosen.

Changes in the Composition of Frozen Beets.

The results given also in Table I (Experiments II, *a*, *b*, and *c*) confirm in general the previous results. With single freezing (*II a*) the invert sugar content increased from 0·15 to 0·22 per cent.; with the portions left for the two days in the freezing state an invert sugar increase of 0·2 per cent. was observed. In the heated samples only an insignificant increase of invert sugar was found, viz., 0·02 per cent.

These experimental results being rather interesting, an attempt was made to examine the effect of a still longer preservation of the samples in the thawed state than in the previous cases, since in practice periods of warmer weather lasting several days certainly occur in winter. In order to obtain as homogeneous a material as possible, a larger beet (from Eastern Slovakia having 13·1 per cent. of sugar, and 0·19 per cent. of invert sugar) was tested, this being divided up by longitudinal slices into nine portions, six of which were introduced into wide reagent bottles which were placed in the ice chest.

After freezing them, the three samples were removed to a room at about 10°C., after which they were returned to the freezing state. The other three portions were sub-divided by a chopping machine, the pulp obtained being also placed in cylinders with about 30 c.c. of ether, the vessel being closed with a treated cork-stopper. The samples at a temperature of about 10°C. were placed in a wide-necked stoppered jar, in the bottom of which some ether had been placed.

By this arrangement the possibility of microbic infection was excluded without destroying the action of the invertase (which was ascertained by preliminary experiments). Examination of the single samples was made both immediately after the freezing and also after 34 and 67 days. At the same time samples of the "etherized" pulp were analysed.

Table II.

	Directly Frozen Beets, Invert Sugar.	Thawed and again Frozen Roots.	Beet Pulp Preserved with Ether.
After freezing	0·19	1·15	1·00
After 34 days	0 47	4·5	7·8
After 67 days	0·81	6·0	8·4

The results are summarized in Table II, where for the sake of brevity only the amounts of invert sugar are given. It is interesting that in the roots which had been once frozen the invert sugar content had risen (from 0·19 to 0·47 and 0·81 per cent.), which probably is to be traced to the bad quality of the roots, and perhaps also is connected with a higher invertase content. But, in the thawed and repeatedly frozen roots, inversion had been disproportionately quicker (from 1·15 to 4·5 and 6·0 per cent.), whilst also in the pulp preserved by means of ether a rapid increase in the invert sugar was observed (1·00 to 7·8 and 8·4 per cent.).

All the series of experiments confirm consistently the view that in beets frozen hard the action of invertase is still exerted, so that the invert sugar during the freezing process is increased, although the effect of micro-organisms is practically precluded under these conditions.

But the course of inversion is considerably accelerated if the frozen roots are thawed, the contents of the cells ruptured by the frost thus becoming mixed, and the beet invertase given every possibility of exerting its effect. Most of all is the beet injured when the duration of the thawing is so prolonged that microbic infection is developed. In both of the cases cited the beet after repeated freezing showed a more rapid increase of invert sugar than that which had only once been so treated.

Hydrogen-ion Concentration as a Basis of Refinery Alkalinity Control.[1]

. By A. A. BLOWSKI and A. L. HOLVEN,

California and Hawaiian Sugar Refining Corp. Crockett, Calif.

Recent developments in the study of true alkalinity and of hydrogen-ion concentration have shown that titrations as made with common indicators are extremely misleading as a means of determining alkalinity or acidity. This latter method of expressing alkalinities is gradually spreading in the sugar world, the present study being developed along lines particularly adapted to practical refinery operations. It started with an investigation of the reliability of the ordinary methods of titration for sugar products and of the interpretation of the results, and led naturally to a brief investigation of the development of acidity in refinery products and finally to the complete development of a simple and effective system of control.

RELATION BETWEEN TITRATED ALKALINITY AND TRUE ALKALINITY.

In order to determine how great the errors caused by using the common indicators were, all the regular refinery products were titrated over a period of about one month with phenolphthalein, litmus, and bromothymol blue. They were also "titrated" to true neutrality (pH 7) by means of an electrometric apparatus. Table I shows the averages of these tests for each product.

Table I.—Comparative Alkalinities of Refinery Products.

(Expressed as equivalent percentages of CaO)
(+ signifies alkalinity, — acidity)

	ALKALINITIES AS DETERMINED			
PRODUCT.	Electro-metrically.	With phenol-phthalein.	With litmus	With bromo-thymol blue.
Affination green syrup	—0.048	—0.082	Acid	—0.052
Affination wash syrup	—0.050	—0.078	Acid	—0.049
Clear affination syrup	+0.003	—0.019	+0.016	+0.002
Clear concentrated sweetwater	Neutral	—0.022	+0.009	+0.001
Second filtration concentrated sweetwater	+0.002	—0.015	+0.011	+0.002
No. 5 liquor	—0.010	—0.022	Neutral	—0.007
No. 55 liquor	—0.001	—0.011	+0.007	—0.001
No. 555 liquor	Neutral	—0.007	+0.007	Neutral
Clear raw liquor	+0.001	Neutral	+0.003	+0.001
Cube liquor (average)	+0.002	+0.001	+0.003	+0.002
Cube liquor (special sample)	+0.001	Neutral	+0.002	+0.001
Cube liquor (special sample)	—0.001	—0.002	Neutral	—0.001
No. 1 liquor	Neutral	—0.002	+0.002	Neutral
No. 2 liquor	Neutral	—0.004	+0.003	Neutral
No. 3 liquor	—0.004	—0.008	Neutral	—0.004
No. 4 liquor	—0.015	—0.021	—0.005	—0.013
No. 1 granulated syrup	Neutral	—0.002	+0.002	Neutral
No. 2 granulated syrup	—0.001	—0.005	+0.002	Neutral
No. 3 granulated syrup	—0.002	—0.007	+0.002	—0.002
No. 4 granulated syrup	—0.010	—0.024	Neutral	—0.010
No. 2 remelt sugar liquor	—0.002	—0.009	+0.007	—0.001
No. 3 remelt sugar liquor	—0.022	—0.040	—0.007	—0.022
No. 2 remelt syrup	—0.015	—0.051	—0.002	—0.010

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[1] Abridged from a paper presented before the Division of Sugar Chemistry at the 70th Meeting of the American Chemical Society, Los Angeles, Calif., 1925.

It will be seen that there is no constant relation between the results secured with the different indicators when used with the different products, also that the use of either of the common indicators, phenolphthalein or litmus, may introduce large errors varying greatly with the different products. For example, with raw liquor, phenolphthalein and litmus show opposite errors of 0·001 and 0·002 per cent., respectively, making a total difference of 0·003 per cent., while with clear affination syrup these indicators show opposite errors of 0·022 per cent. and 0·013 per cent. a total difference of 0·035 per cent. It is to be noted that the error is greatest with products of low purity, and for products of similar purity is greatest for those which have received the least char filtration. It is also evident that bromothymol blue gives practically accurate results with all products.

It appeared quite definite from these results that phenolphthalein and litmus are actually misleading when used for alkalinity determinations of cane sugar products. The immediate conclusion, of course, is that bromothymol blue is a much more satisfactory indicator to use. For a short period, therefore, until the use of hydrogen-ion measurements was started, this indicator was put into use at the C. & H. refinery as the standard for practically all alkalinity work.

RELATION BETWEEN TITRATED ALKALINITY AND *pH* CONCENTRATION.

To determine what the titrated total alkalinities and acidities actually meant in terms of active alkalinities and acidities, a number of the standard products were tested for hydrogen-ion concentration as a routine matter for a short period, as well as being titrated. The hydrogen-ion concentration was determined at first by colour comparison with buffer solutions in tubes, and later by spot tests. The averages of these results are shown in Table II.

Table II.

Relation between Titrated Alkalinity and H-Ion Concentration.

PRODUCT.	Titrated alkalinity (bromothymol blue)	*pH*
Raw liquor	+0.001	8.25
Cube liquor	+0.002	8.50
	+0.001	8.25
	−0.001	6.50
No. 4 liquor	—0.015	6.00
No. 4 syrup	—0.010	6.20
No. 55 liquor	—0.001	6.80
No. 5 liquor	—0.010	6.40
Second filtration concentrated sweet-water	+0.002	7.30
Clear affination syrup	+0.003	7.25
Affination green syrup	—0.048	5.60

This list gives some indication of the lack of uniformity in the relationship between total alkalinity or acidity and H-ion concentration. For example, an acidity of 0·001 per cent. in cube liquor gives practically the same hydrogen-ion concentration as ten times as great a titrated acidity in No. 5 liquor, while an alkalinity of 0·001 per cent. in cube liquor gives a higher acidity (about ten times the hydroxyl-ion concentration) than three times as great a titrated alkalinity in clear affination syrup.

To develop this point better, a number of different types of sugar products were made up to definite total acidities and alkalinities by adding definite quantities of N/28 sulphuric acid and N/28 sodium hydroxide to the neutral solutions. The hydrogen-ion concentrations of these products are shown in Table III.

Table III.—H-Ion Concentration (pH) at various Total Alkalinities.

PRODUCT	Apparent purity coefficient	Alkalinity, Per cent CaO						
		+0.050	+0.020	+0.010	+0.005	+0.002	+0.001	Neut.
No. 1 liquor	99+	—	—	—	9.50	8.75	8.50	7.00
Raw liquor	99+	—	—	9.50	9.00	8.25	7.50	7.00
No. 4 liquor	90	10.00	9.00	8.60	8.00	7.25	7.10	7.00
No. 55 liquor	85	9.65	8.75	8.25	7.35	7.15	7.05	7.00
No. 2 remelt sugar liquor	89	9.25	8.35	7.50	7.25	7.10	7.00	7.00
Concentrated sweet-water	80	9.00	8.25	7.25	7.15	7.00	7.00	7.00
Affination green syrup	80	8.35	7.50	7.25	7.00	7.00	7.00	7.00
No. 2 remelt syrup	56	8.35	7.50	7.25	7.05	7.00	7.00	7.00
		−0.001	−0.002	−0.005	−0.010	−0.020	−0.050	−0.100
No. 1 liquor	99+	6.00	5.50	4.25	—	—	—	—
Raw liquor	99+	6.50	6.00	5.25	4.25	—	—	—
No. 4 liquor	90	6.75	6.50	6.25	5.90	5.25	4.50	—
No. 55 liquor	85	6.90	6.75	6.40	6.00	5.75	4.75	—
No. 2 remelt sugar liquor	89	7.00	6.90	6.60	6.00	5.75	5.25	4.25
Concentrated sweet-water	80	7.00	7.00	6.90	6.75	6.50	6.00	5.50
Affination green syrup	80	7.00	7.00	7.00	6.90	6.75	6.25	5.50
No. 2 remelt syrup	56	7.00	7.00	7.00	6.90	6.60	6.00	5.50

Although only strong acids and alkalis were used in these tests, the results show very strikingly the effects of the buffer substances that are normally present. It is clear from this tabulation that there is no uniform relationship between the total alkalinity and the hydrogen-ion concentration of the various refinery products—nothing that would make it possible to judge of one from the other. For example, raw liquor, with an acidity of 0·005, shows a *pH* of 5·25 (sufficient to cause a very active inversion), whereas affination syrup at the same acidity shows no measureable change of the hydrogen-ion concentration.

Those familiar with refinery practice know that there are large seasonal variations in the character of the products. These are due in part to changes in the character of the raw sugar, which presumably come as a result of changes in the cane as the season progresses, and in part to variations in the refinery operation. For example, changes in the rate of melt almost necessarily mean changes in the intensity of char filtration, this, of course, greatly affecting the character of the final products, particularly the amount of the buffer substance left in them. Therefore, this irregularity of relationship between total alkalinity and hydrogen-ion concentration must exist, not only between different products, but also, to some extent, between similar products at different times.

As inversion of sucrose and decomposition of glucose, both of which are of great concern to the sugar refiner, are so dependent on hydrogen-ion concentration, the conclusion is obvious that titrations are practically worthless as a means of refinery alkalinity control, and that some convenient means of hydrogen-ion control is necessary.

For this reason, as explained in a later section of this paper, a very rapid and accurate means of determining hydrogen-ion concentration was developed for use in the plant control.

DEVELOPMENT OF ACIDITY IN REFINING.

It was formerly the custom to lime only one or two products at the beginning of the refining process, letting others take care of themselves. As the liquors and syrups, in going through the refinery, are continually under the influence of heat and therefore subject to the development of acidity through decomposition of glucose, it was thought best to make a survey of the plant to determine if it were not necessary to lime many more products.

As might be expected, it was found that there was a development of acidity all along the line. Table IV shows the more important changes that were found to take place as the liquors passed through the plant.

Table IV.

Changes in H-Ion Concentration in the Refinery.

ORIGINAL PRODUCT.	*pH.*	RESULTING PRODUCT.	
Unfiltered raw liquor	7 35	Cloth filtered raw liquor	7.20
Raw liquor entering char	7.20	No. 1 liquor	7.00
Granulated syrup mixture entering char	7.20	No. 2 liquor No. 3 liquor	6.50 6.30
Clear affination entering char	7.20	No 555 liquor	6.70
Average of all liquors entering char	7.00	Char sweetwater	5.50 to 5.75
Products boiled in No. 1 remelt massecuite	6.90	No. 1 remelt sugar No. 1 remelt syrup	6.65 6.40
No. 1 remelt syrup boiled into No. 2 remelt massecuite	6.40	No. 2 remelt sugar No. 2 remelt syrup	6.20 5.95
No. 2 remelt syrup	5.95	No. 3 remelt sugar	5.35

Although all the refinery products are not listed, merely those that illustrate the point, it is clear that there is a development of acidity in all the refining processes where liquors undergo heat.

In order to minimize inversion without securing excessive decomposition of invert sugar, it is generally considered good policy to keep liquors as close as possible to *pH* 7·0. It will be seen that quite a number of products show a distinct drop below that point—particularly the char sweetwater and the remelt products. As a result of these observations, therefore, in laying out the system of control, provision was made for neutralizing acidities in entering products as soon as possible and thereafter neutralizing any marked acidity that developed as the material passed through the house.

ESTABLISHMENT OF AN EFFICIENT ALKALINITY CONTROL.

The main object of alkalinity control in a sugar refinery is, of course, to minimize inversion of sucrose. This, however, should be done in such a way that there is the smallest possible destruction of glucose and the smallest possible introduction of lime. It is believed that this result can be best secured by keeping all the products at or close to neutrality—that is, at a *pH* of 7·0. An attempt to maintain alkalinities above this point merely results in decomposition of glucose with a resulting drop in alkalinity, which causes an unnecessary increase in lime salts, whereas below this point the rate of inversion of sucrose increases rapidly.

In order to establish a system that would accomplish these desired results, it was considered necessary that the following requirements be satisfied :—

1. A quick, easy, and accurate means of determining the hydrogen-ion concentration of refinery products should be available.

2. Provision should be made for making frequent tests on practically all products throughout the plant.

3. Provision should exist for liming as many products as necessary and for accurately controlling the addition of lime.

1. *Making pH test:*—The first of these requirements was the most difficult to satisfy in a really practical way. Electrometric apparatus was, of course, too cumbersome for consideration. Colorimetric tests made by adding indicators to diluted samples of sugar products in tubes were more rapid, but the natural colours of the solutions diminished the accuracy of the results. The test finally adopted was a spot test, by which a few drops of the product to be tested (properly diluted, if necessary) are put into each of three depressions in a porcelain spot plate and appropriate indicators added—phenolphthalein, bromothymol blue, and methyl red. After much effort a satisfactory colour chart was prepared, in collaboration with an expert in photographic tinting, by the use of dyes on gelatin-coated celluloid.

2. *Provision for frequent tests.*—A number of testing hoods were installed at the various stations, small cabinet-like structures, curtained off from ordinary light sources, and provided with daylight lamps and with colour charts, glassware, and all reagents and equipment necessary for testing the products. An "alkalinity controller," generally a young chemist, is provided on each shift, testing all products that are limed, and also a number for record purposes only.

3. *Liming equipment.*—In order to permit of proper liming, it is necessary that the lime be easy to regulate, be continuous in application—and be distributed over the entire house.

The first of these conditions was secured by working with very thin lime, viz., at 2° Brix. which permits of very exact regulation. The second and third conditions were met by installing a circulating system by which this thin lime is circulated throughout the refinery, wherever products are limed. Valves and drops are provided for all tanks in which lime may be required.

In operation this system is very simple. The "alkalinity controllers" make their rounds at regular intervals, testing the various products and recording the results so that they are available to the operators and foremen at all times—calling attention, of course, to any unusual conditions. The operators regulate the flow of lime to the various products so as to maintain the hydrogen-ion concentrations very close to *pH* 7·0. At a few stations, where close control is required, the operators make additional tests.

The value of this control may be appreciated when it is realized that the introduction of lime into process has been reduced from a former figure of about 150 lbs. per 100 tons melt (0·075 per cent.) to about 75 lbs. per 100 tons melt (0·037 per cent.), thus materially reducing the burden on the char and reducing molasses production. The main advantage, however, has been the fact that with this small introduction of lime it has been possible to maintain nearly all the products in the refinery in a neutral or slightly alkaline condition, whereas formerly, even with a large consumption of lime, there were many acid conditions throughout the house.

Dr. O. SPENGLER, of Dessau, has been chosen as the successor of Dr. A. HERZFELD, as Director of the Institut fur Zuckerindustrie, of Berlin, which appointment has been confirmed by the Prussian Minister of Agriculture.

The Mirrlees Watson Co., Ltd., of Glasgow, have been successful in securing against severe Continental competition an order for a sextuple effect distilling plant for the Port of Jeddah, Arabia. This plant will be capable of producing 150 tons of fresh water from sea water per 24 hours, and will be erected on the site by the Company, complete with the necessary boilers and pumps. This distilling plant is the second installation for Jeddah, and the 14th which has been supplied by this well-known firm at various places on the shores of the Red Sea.

Mill Data of Ten Philippine Centrals, 1924-25 Crop.

	Calamba	Del Carmen	Hawaiian Philippine	Isabela	La Carlota	Ma-oa	Mindoro	San Carlos	San Fernando	Talisay-Silay
Cane—	1600	2500	1500	1200	2000	2000	1100	1500	1200	2000
Tons (metric)	251970·48	468794·84	410760·63	177232·23	439063·00	305229·27	57785·01	220525·92	243868·09	299009·58
Polarization	11·86	12·35	12·40	12·55	12·74	12·61	10·48	14·26	12·37	12·70
Fibre, per cent.	11·06	11·99	11·80	10·77	11·13	11·69	13·63	12·96	11·88	11·34
Sugar—										
Tons made	25797·91	49477·02	44397·52	19276·49	50127·46	33271·94	5500·47	29368·81	25792·04	34702·94
Weight per 100 of cane	10·24	10·55	10·81	10·88	11·42	10·90	9·52	13·32	10·58	11·61
Polarization per 100 of cane	9·91	10·18	10·42	10. 51	11·01	10·51	9·16	12·85	10. 21	11. 23
Bagasse—										
Per cent. polarization	3·01	3·38	3·62	4·30	3·69	3·49	2·23	2·77	3·87	2·96
Moisture, per cent.	49·35	47·82	49·11	45·58	47·00	47·77	39·96	47·28	49·22	45·28
Fibre, per cent.	46·72	47·28	46·08	48·92	48·12	47·51	56·83	49·16	45·47	50·78
Weight per 100 of cane	23·68	25·37	25·62	22·01	22·55	24·60	25·18	26·36	26·14	22·32
Polarization per 100 of cane	0·72	0·86	0·93	0·95	0·83	0·86	0·56	0·73	1·01	0·66
Press Cake—										
Polarization, per cent.	2·93	5·28	5·60	3·10	2·46	6·87	2·10	—	3·55	—
Polarization per 100 cane	0·07	0·10	0·10	0·06	0·05	0·15	0·03	0·00	0·06	0·00
Lime—										
CaO per ton cane in kg.	0·59	0·57	0·65	0·84	0·75	1·21	0·90	1·06	0·50	0·63
Final Molasses—										
Brix	87·20	87·21	87·94	89·80	89·90	89·13	91·41	90·24	89·92	89·34
Sucrose, per cent.	33·44	34·68	32·02	33·35	30·06	37·13	30·74	33·03	34·26	32·15
Gravity purity	38·35	39·77	36·41	37·10	33·44	41·66	33·63	36·60	38·10	35·99
Tons	8766·71	17785·42	11478·67	4902·73	12628·03	*11184·79	1602·40	4600·28	8058·45	7131·73
Sucrose per 100 cane	1·16	1·31	0·89	0·92	0·86	1·36	0·85	0·69	1·14	0·77
Undetermined Losses—										
Polarization per 100 cane	0·01†	0·10†	0·06	0·11	0·01†	0·27†	0·12†	0·01†	0·04†	0·04
Pol. per 100, pol. of cane	0·07†	0·77†	0·44	0·84	0·09†	2·18†	1·19†	0·08†	0·32†	0·32
Total Losses—										
Polarization per 100 cane	1 94	2·17	1·98	2·04	1·73	2·10	1·32	1·41	2·17	1·47
Pol. per 100, pol. of cane	16·37	17·58	15·96	16·24	13·59	16·65	12·60	9·86	17·51	11·56
Milling—										
Extraction pol. per cent., pol. of cane	93·98	93·06	92·52	92·45	93·47	93·19	94·64	94·89	91·82	94·80
Tons cane per hour	71·80	106·03	85·10	46·84	109·99	76·99	36·40	62·72	63·71	79·56
Tonnage fibre ratio	24·69	23·54	28·52	—	23·71	21·26	16·57	25·27	23·04	26·05
Per cent. dilution	15·87	9·41	12·62	12·12	13·09	11·20	22·69	10·89	10·59	13·76
First Expressed Juice—										
Brix	17·24	18·18	17·71	17·80	18·15	18·11	15·86	19·47	17·75	18·40
Apparent purity	83·24	82·50	84·58	85·70	84·85	84·00	82·85	89·78	83·20	84·70
Mixed Juice—										
Brix	14 18	16·15	15·14	15 10	15·51	15·71	12 47	—	15·77	—
Apparent purity	81·45	80·16	83·06	83·40	82·20	82·30	79·83	—	81·20	—
Last Expressed Juice—										
Brix	5·32	5·00	6·97	8·30	4·92	9·28	3·57	7·61	6·66	5·10
Apparent purity	76·59	68·99	74·89	78·50	75·61	73·90	69·52	77·79	72·80	74·10
Syrup—										
Brix	63·20	62·27	58·48	53·70	64·13	64·32	64·93	65·77	61·16	59·00
Apparent purity	82·86	82·08	83·65	84·00	84·00	83·80	82·56	88·38	82·10	84·50

* Theoretical Molasses.

† Gain undetermined.

Some Philippine Factory Capacity Data.

		Standard.	La Carlota	Del Carmen	Ma-ao
1	Milling Equipment		2RC 78	2RC 78	3RC 78
2			9RM 78	9RM 78	12RM 78
3			2RC 78	2RC 78	—
4			9RM 78	15RM 78	9RM 78
5	Capacity per day at tonnage ratio				
6	of 2·0	1,000	2,375	3,023	2,591
7	Cane per day, metric tons		2,526	2,389	1,608
8	Per cent. Capacity		106·36	79·03	62·06
9	Furnaces		16	16	12
10	Sq. Ft. grate area		—	880	320
11	Per ton cane		—	0·37	0·20
12	Cu. ft. combustion volume		—	8,752	4,910
13	Per ton cane		—	3·66	3·05
14	Boilers		8	8	6
15	Rated horse power	2,000	4,000	5,040	3,600
16	Per ton cane	2·00	1·58	2·11	2·24
17	Per cent. Standard	100	79·00	105·50	112·00
18	Juice Heaters		4	4	4
19	Sq. ft. H.S.	1,750	3,600	3,800	2,800
20	Per ton cane	1·75	1·43	1·59	1·74
21	Per cent. Standard	100	81·71	90·86	99·43
22	Settling Tanks		32	28	13
23	Cubic feet...	4.000	9,000	9,156	9,150
24	Per ton cane	4·00	3·56	3·83	5·69
25	Per cent. Standard	100	89·00	95·75	142·25
26	Filter-Presses		16	20	10
27	Sq. ft. filter area	6,000	9,600	14,120	8,000
28	Per ton cane	6·00	3·80	5·91	4·98
29	Per cent. Standard	100	63·33	98·50	83·00
30	Evaporators...		2	2	1
31	Sq. ft. H. S.	15,000	30,000	40,000	22,000
32	Per ton cane	15·00	11·88	16·74	13·68
33	Per cent. Standard	100	79·20	111·60	91·20
34	Syrup Supply Tanks		8	5	4
35	Cubic ft.	2,500	3,360	2,090	3,360
36	Per ton cane	2·50	1·33	·87	2·09
37	Per cent. Standard	100	53·20	34·80	83·60
38	Molasses Supply Tanks		8	8	4
39	Cubic ft.	2,500	3,360	3,178	3,360
40	Per ton cane	2·50	1·33	1·33	2·09
41	Per cent. Standard	100	53·20	53·20	83·60
42	Vacuum Pans		5	5	4
43	Cubic Feet	3,000	3,650	4,000	4,700
44	Per ton cane	3·00	1·44	1·67	2·92
45	Per cent. Standard *	100	40·11	41·54	81·79
46	Crystallizers		32	26	44
47	Cubic Feet	15,000	25,600	23,400	†52,800
48	Per ton cane	15·00	10·13	9·79	32·84
49	Per cent. Standard	100	55·17	47·04	180·04
50	"A" Centrifugals...		12	14	10
51	Sq. ft. screen area	100	252	305	210
52	Per ton cane	·100	·100	·128	·131
53	Per cent. Standard	100	100·00	128·00	131·00
54	"B" Centrifugals...		20	18	20
55	Sq. ft. screen area	275	420	377	420
56	Per ton cane	·275	·166	·158	·261
57	Per cent. Standard	100	49·26	41·47	78·14
58	Mixed Juice Purity	85·00	82·20	80·16	82·30

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* Taking into consideration the purity of mixed juice.
Standard per ton of cane for 85 purity mixed juice are: Pans, 3·00 cub. ft.; Crystallizers, 15·00 cub. ft.; "B" Centrifugals, 0·275 sq. ft. screen area.
For every degree below or above 85 purity, add or deduct 7 per cent. for Pans, 8 per cent. Crystallizers and Centrifugals.

† Including storage tanks for low grade masseeuite.

‡ Purity mixed juice estimated by deducting 3·0 from the purity of first expressed juice.

Some Philippine Factory Capacity Data.

	Talisay-Silay	Hawaiian-Philippine	Isabela	Calamba	San Carlos	Mindoro
1	2RC 78	3RC 78	3RC 54	2RC 72	2RC 72	2RC 84
2	9RM 78	12RM 78	9RM 54	12RM 78	12RM 78	9RM 84
3	2RC 78	—	—	—	—	—
4	9RM 78	—	9RM 78	—	—	—
5						
6	2,375	1,620	1,593	1,480	1,480	1,377
7	1,445	1,705	977	1,562	1,453	580
8	60·84	105·25	61·33	105·54	98·18	42·12
9	14	12	8	14	—	—
10	480	560	272	339	—	—
11	0·33	0·33	0·28	0·22	—	—
12	5,620	5,744	—	2,125	—	—
13	3·89	3·37	—	1·36	—	—
14	7	6	6	12	—	—
15	3,890	3,618	2,576	3,350	—	—
16	2·69	2·12	2·64	2·14	—	—
17	134·50	106·00	132·00	107·00	—	—
18	5	4	2	4	—	—
19	4,500	2,260	1,800	3,362	—	—
20	3·11	1·56	1·84	2·15	—	—
21	177·71	89·14	105·14	122·86	—	—
22	2	16	16	24	—	12
23	8,100	8,160	4,000	6,468	—	—
24	5·61	4·79	4·09	4·14	—	—
25	140·25	119·75	102·25	103·50	—	—
26	0	12	8	14	0	8
27	—	8,160	5,104	8,035	—	—
28	—	4·79	5·22	5·14	—	—
29	—	79·83	87·00	85·67	—	—
30	2	1	2	2	—	—
31	30,000	20,128	14,400	33,080	—	—
32	20·76	11·81	14·74	21·18	—	—
33	138·40	78·73	98·27	141·20	—	—
34	10	3	8	5	7	6
35	4,200	3,600	2,000	2,250	2,800	2,573
36	2·91	2·11	2·05	1·44	1·93	4·44
37	116·40	84·40	82·00	57·60	77·20	177·60
38	6	3	5	5	7	9
39	2,520	3,600	2,000	2,298	2,800	3,114
40	1·74	2·11	2·05	1·47	1·93	5·37
41	69·60	84·40	82·00	58·80	77·20	214·80
42	4	3	3	4	4	3
43	3,384	3,780	2,390	3,588	2,865	2,300
44	2·34	2·22	2·45	2·20	1·97	3·97
45	63·41	65·10	73·35	61·33	74·90	97·07
46	28	24	22	24	16	14
47	22,400	34,800	†14,300	18,696	11,600	12,970
48	15·50	20·41	14·64	11·97	7·98	22·36
49	81·75	117·77	86·52	62·15	62·05	105·47
50	8	8	6	8	9	6
51	168	168	126	175	189	126
52	·116	·099	·129	·122	·130	·217
53	116·00	99·00	129·00	112·00	130·00	217·00
54	16	16	14	15	15	10
55	336	336	294	325	315	210
56	·233	·197	·301	·208	·217	·362
57	66·95	61·95	97·10	58·92	91·95	93·06
58	‡81·70	83·06	83·40	81·45	‡86·78	79·83

Brevities.

Several bagasse scales have been under test lately in Java, and certain have been rejected as being unsuitable. But the Boulogne apparatus[1] for weighing juice or water has proved particularly satisfactory.

Economizers, operating on the Green system and provided with mechanically operated scrapers, have been in operation last year in two factories in Java, and it is estimated[2] that as the result of their installation there has been a saving of fuel amounting to 6–7 per cent.

During the 1924-25 session at Trinidad College the model sugar factory ran its first season. Throughout it worked well and was remarkably free from stoppages. It ran for 74 working days, mostly for 24 hours a day, grinding 2600 tons of cane a day and delivering 246 tons of sugar.

An unfavourable report has been made by the Java Experiment Station on the method of desaccharifying molasses by the use of baryta,[3] the principal objection being the poisonous nature of this chemical, whilst the fact that it is necessary to destroy all the reducing sugars is another reason for its rejection.

Count LOUIS HAMON[4] foreshadows that high quality activated carbon made from peat may soon be sold at the low price of about £10 per ton by his company Artificial Coal Products (Hamon Process), Ltd., which has an authorized capital of £200,000. A factory costing £100,000 is to be erected on an estate of 800 acres, it is stated, and by-products will include disinfectants, ammonium sulphate, and paraffin wax.

A polariscope tube with side-filling opening, the whole formed of one piece of glass, is now being made in London, according to United Kingdom Patent No. 103, 233 of 1926. It has the advantages that it is quite free from the optical troubles caused by over-screwing, from the rubber washers perishing, and from leakage. These tubes are of unchangeable length, and their precision in 100, 200, and 220 mm. lengths is guaranteed.

In several Java factories the admixture of juice and milk-of-lime has been shown to be insufficient, titrations showing a considerable variation in the reaction of the limed juice. But a considerable improvement in this direction has been effected by arranging means for blowing in air (from the air reservoir of the sulphitation apparatus), titration figures having been obtained that are practically constant throughout when using milk of as even a CaO content as possible.

The new mill erected in the Tully District, Queensland, grinds about 1200 tons of cane per day of 24 hours. Its crushing plant consists of a Searby shredder and four 3-roller mills each 72 in. × 34 in.; the quadruple has a h.s. of 20,000 sq. ft.; and there are four pans (two coil and two calandria), eight crystallizers 7 ft. 3 in. diam. by 26 ft. long, and 16 electrically-driven centrifugals. Its approximate floor area is 70,000 sq. ft. Three Bellis-Morcom electric generating sets supply the power to drive the motors operating the pumps, elevators, crystallizers, centrifugals, cane rakes, etc., and lighting. Excepting the electrical plant, centrifugals, and crystallizers, this plant has been manufactured locally, the major portion being supplied by Walker's Foundry, Bundaberg Foundry, and Barbat & Sons.

The American Institute of Chemists has adopted a code of ethics governing professional conduct towards employers, partners, clients, fellow chemists, and the public. This code does not differ in essence from that which is enjoined by the authorities of professional bodies in Great Britain on their members. It is noteworthy, however, that it permits members to advertise "in a dignified manner, being careful to avoid misleading statements"; whereas the by-laws of the Institute of Chemistry, London, entirely forbid soliciting for practice. The first clause of this finely expressed American Code reads:— "Every individual on entering the profession of chemistry and thereby becoming entitled to full professional fellowship, incurs an obligation to advance the science and art of chemistry, to guard and uphold its high standard of honour, and to conform to the principles of professional conduct."

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[1] *Archief*, 1925, 33, 4e deel; Verslagen 1e afl., 14, also *I.S.J*, 1922, 497, 1925, 588.

[2] *Archief*, 1925, 33, 4e deel; Verslagen 1e afl., 12.

[3] *Archief*, 1925, 53, 3e deel; Verslagen, 1e, afl. 18; see also *I.S.J.* 1923, 51; 1924, 442.

[4] See U.K. Patent, 231,936; *I.S.J.*, 1925, 393.

[5] *Archief*, 1925, 33, 4e deel; Verslagen 1e, 16.

Brevities.

M. REIJGERSBERGH[1] believes in the nipa palm as a source of sugar and of alcohol, especially in countries where it at present is already cultivated. It is probably as a producer of raw material for alcohol fuel manufacture that its future lies. One should be able to count on a production of 750—900 litres of 95 per cent. spirit per acre.

In Java some trouble has been experienced with the "lumping" of white sugar, and as a means of contending against it a kind of dryer has been experimented with in one of the factories.[2] It is of sheet-iron, about 36 ft. high, the sugar being raised by a Jacob's ladder and allowed to fall down it, whilst air is blown up from below, the whole being enclosed, so as to obviate dust formation. It is stated that after passing through this apparatus, the sugar is well dried, and no longer lumps.

Different factories in Java acting on the recommendation of the Experiment Station have experimented on the burning of molasses, mixing this with the bagasse directly after the last mill; and the majority report successful results.[3] In the case of factories reporting less favourable results (in one case much trouble from clinkering), it is believed that admixture was insufficiently thorough, and that furnace construction and composition of molasses are less likely causes of the difficulties which arose.

A recently published book of considerable interest is F. R. HARRIS' "Jamsetji Nusserwanji Tata" (Oxford University Press), which gives accounts of Mr. Tata's great enterprises, such as the development of the Empress Cotton Mills, the Iron and Steel Company, the Hydro-Electric Companies, and the Institute of Science, Bangalore. The magnitude of these and allied enterprises in increasing the prosperity of India may be indicated by the fact that the combined capital invested in them is estimated to amount to nearly seventy million pounds.

In large-scale field tests officially carried out in 1925 by the Comité Central des Fabricants de Sucre de France in that country on the relative values of a number of German, Dutch, Polish, and Czecho kinds of beet seed, that of Janasz came out well on top in regard to sugar content in the roots. It gave a figure no less than 19·14 per cent. whereas the next lowest was 18·28, a difference of 0·86 per cent., and the lowest of all 18·03 per cent. In regard to yield of sugar in kilos per hectare, it also made a good showing, though somewhat surpassed by Dutch and German grades. Similar satisfactory results have been obtained by Janasz seed elsewhere, namely in Poland, when this seed gave roots of 18·43 per cent., its rivals giving 17·44 and 17·73 per cent. As for the sugar in kilos per hectare, here Janasz was also superior and easily so, the three values being 5743, 5475 and 5389.

A very cleverly edited monthly is "Through the Leaves," published by the Great Western Sugar Company, of Denver, Colorado, for the promotion of efficient method of crop production, particularly of beet cultivation. Recent numbers contain practical pithy articles for the farmer on such subjects as "Crop Rotation"; "Dried Beet Pulp as a Lamb Feed"; "Effect of Beet Culture on Grain Yields"; "Sugar Beet Breeding"; "Feeding of Beet Tops"; etc., etc. A campaign is being conducted in its pages for "leaving the big beet in the bunch" during thinning, and many examples are given of farmers having increased their yields considerably, sometimes by as much as 5 tons. Yields "up in the twenties" are reached in this part of the U.S., some as high as 24 and 26 tons of roots per acre, though the sugar content of these roots, and the sugar produced per acre, is not at the same time reported.

The American Society for Testing Materials is an organization for "the promotion of knowledge of the materials of engineering, and the standardization of specifications and the methods of testing." These objects are attained by the presentation and discussion, at annual meetings, of scientific and technical papers and committee reports on the properties and testing of a wide variety of engineering materials: for example, steel. iron and non ferrous metals and alloys; cement, lime, gypsum and clay products, refractories; paints and oils, petroleum products and lubricants, road materials, coal and coke, timber and timber preservatives, shipping containers, insulating and waterproofing materials, rubber and textiles. In addition to papers, discussions of important topics are held at each annual meeting, so that the *Proceedings* annually contain information of exceeding value to all who produce, use, or test materials of engineering. The annual dues are $15 and there is no entrance fee.

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[1] *De Indische Culturen*, 1925, 641; through the *Archief*, 1925, **33**, No. 46 124[illegible]—1253.

[2] *Archief*, 1925, **33**, 4e deel; Verslagen, 1e, 18-19.

[3] *Archief*, 1925, **33**, 4e deel; Verslagen 1e afl., 12.

Review of Current Technical Literature.[1]

RAPID COOLING OF LOW-GRADE MASSECUITES IN CRYSTALLIZERS. *Herbert Walker.* *Sugar News, 1925, 6, No. 10, 588-590.*

Experiments made in Porto Rico in open U-type crystallizers (750 cub. ft. capacity) indicate that after 12 hours' cooling of an average massecuite (about 54° purity) the supersaturation had been reduced to such an extent that the whole mass might have been cooled down to factory temperature in two hours if that were possible without danger. At Talisay-Silay Central there was developed a simplified type of cooling device which appears to meet the requirements of rapid and efficient cooling at a moderate cost. This consists of a set of stationary pipe coils which are inserted in an ordinary air cooled crystallizer. Each coil extends from top to bottom of the crystallizer and is shaped approximately to conform to a transverse section thereof, so fitting across the crystallizer at right angles to the longitudinal shaft. Spacing of the pipe in each coil and of coils from each other is designed to permit free movement of the massecuite and give each coil a comparatively small volume to cool. The original stirring equipment is used after removing the outer ribbón, but leaving the stirring arms and adjusting the latter to fit in between the rows of coils. Coils installed in an 800 cub. ft. crystallizer have a total cooling area of somewhat over 300 sq. ft., which is approximately the cooling surface of a water-jacketed crystallizer of this capacity, but the former is more efficient than the latter, since its cooling coils extend through the centre of the massecuite instead of around the sides. A slight advantage is also gained by leaving the sides and ends free to radiate heat as in ordinary air cooling. The cooling water in each coil enters at the top of each coil, goes directly to the bottom at one side of the crystallizer, rises through successive lengths of horizontal pipe connected by bends and emerges at the top of the opposite side. Coils are connected to a common header, but are provided with separate valves for individual regulation. Tests made showed that it was easily possible to cool massecuite to factory temperature in from 24 to 36 hours with water at 86° F., whereas ordinary crystallizers require about a week for complete cooling. No false grain developed when boiling at an average Brix and purity of 94·9° and 57·7 (but at Pampanga, where a less fluid massecuite was worked it was not possible to confirm the results achieved at Talisay). These satisfactory results obtained at Talisay over a period of several months were, however, sufficient to demonstrate to the author the value of crystallizers capable of rapid cooling, especially to a central lacking capacity in this part of the plant, at least twice the volume of massecuite thus being handled.

CLARIFICATION (LIMING AND FILTRATION) IN THE P.I. *Wm. Paterson.* *Reports of the Third Annual Convention of the Philippine Sugar Association, 1925.*

Philippine juices invariably respond to an alkaline reaction in clarification (liming to a faint pink, using phenolphthalein indicator, and subsequently heating the juice almost to boiling point), as the result of which treatment they become bright and sparkling and assume a clear amber colour, no difficulty being experienced in subsiding, boiling or curing. Last year two centrals tried heating previous to liming, and obtained results as good as in the ordinary procedure with the advantage, however, that the formation of incrustation in the juice-heaters was largely diminished. Mud liming previous to filtration demands attention, and in the P.I. this operation appears to be carried out in many instances in a very haphazard fashion, too great a lime addition being made. Suitable means should be provided to enable the return of juice from the filter-presses to the mixed juice when it is turbid; and the use of two small tanks is suggested, side by side, one for the clear filtered juice, this being connected with the evaporator supply, and the other for turbid juice, this connected with the mixed juice tanks, careful supervision and testing of the filtered juice being made for clarity all the time. Often it is the practice to return the filter-pressed juice to the mixed juice as a precautionary measure against turbid or dirty juices occasioned by a leaky press or a broken cloth. But by sending the filtered juices direct to the evaporator, settling tank capacity is economized, and (what is more important) the evaporator obtains properly filtered juice, which is better than the best resulting from subsiding.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

WHAT THE MANUFACTURER EXPECTS OF THE JUNIOR CHEMIST. *Gustave J. Lemmens. Journal and Proceedings of the Institute of Chemistry, London, February, 1926, 48-56.*

"One of the many advantages of college training, from which I am assuming that the junior chemist, who is our subject, has more or less recently emerged, is that it promotes certain special social qualities, and technical experience therein, that are essential for such work, as well as practical experience in some of the higher qualities that lubricate life,—self-sacrificing service, team work, and *esprit de corps*. . . . . It is still the fashion to some extent for the rest of the staff in a large organization, including the management, to look somewhat askance at the laboratory. This is partly the fault of the critics and partly the fault of the chemists. . . . . It is the duty and personal interest of every chemist to popularize his profession by fair means or foul. . . . . The best thing that chemists individually and collectively can do in their own personal interests is to enlarge the demand for their services by popularizing themselves and their activities. The two ways of popularizing the laboratory department are efficiency in its operation and the promotion of goodwill toward its personnel among the rest of the staff. The latter is best done from the bottom, by cultivating friendly relations with the workmen. . . . . The two leading direct demands that the management will make on the junior chemist's work are reliability and speed. . . . . Now, manipulative accuracy is easy ; junior chemists who can make routine determinations to a high degree of manipulative accuracy, are three-a-penny ; but the man who can give you as good a result from one determination as from twenty, and takes the necessary precautions to ensure it, is a man. . . . . Perhaps one of the most useful faculties in securing reliability and speed is a thorough understanding of the theory of errors and probabilities. The junior chemist should thoroughly grasp the significance and use, as working tools, of the average, the weighted average, the mean, arithmetic and geometric, the median and the mode. The practice, as a pastime, of analysis of the elements of error inherent in any determination, is a most useful exercise, not on its own account, but because it will open up a wide field of information as to the direction in which special care must be taken and where it can be relaxed ; will promote a special sense of estimating how largely any given factor looms in the final result. . . . . Another useful aid to speed and reliability is strict standardization of method, even down to mimeographed forms for entry of observations. It is remarkable how methodical organization of routine determinations simplifies them. The ingenious mind will even devise complex circular slide-rules, which are easily made photographically. Such standardization has special advantages of its own. In many routine determinations, such for example as moisture content, it is far more important to establish the amount of successive variations from the normal, up or down, and whether, and in which direction, there is any tendency to change as successive batches of product are turned out, or successive batches of supplies are received, than that the absolute figures should be known. That is to say, a constant error, due to method, is relatively unimportant so long as it is constant, and variations are reliably recorded. . . . . He should also be an insatiable reader and "bung full" of curiosity, but his reading and curiosity, equally with his imagination, must be under strict control and be directed to a definite end, by which I do not mean narrow specialism but the avoidance of dilettanteism. It is an invaluable habit to record regularly the fruits of his reading and satisfied curiosity,—not in detail ; because no mind but the narrowest will persevere against the tedium of making continuous records, although this tedium will be much mitigated by habit. No one can be expected to retain all the information that one acquires casually, but a very great deal can be done by maintaining a 5 by 3 in card index, and carrying a loose-leaf pocket book with leaves of the same size, which can be detached and slipped among cards. . . . . These are not, I assure you, merely academic exercises, but they enable one to clothe the bare bones of recorded chemical facts with living tissue, and turn our daily drudgery into a fascinating reality."

ESTIMATION OF THE ERRORS INVOLVED IN THE DETERMINATION OF THE PURITY BY ASSISTANTS IN LARGE LABORATORIES. *P. F. Baerts and A. Lechat. La Sucrerie Belge, 1925, 45, Nos. 6 and 7, 37-43, 69-81.*

In determining the apparent purity in routine operation in a large laboratory, the total error will depend essentially on the quality and number of the pieces of apparatus in use, as well as on the skill and on the number of the operators; and it is of importance to know this error for the comparison of the control sheets of a number of factories. In this article mathematical formulæ are applied for the calculation of the various average errors likely to arise under various conditions in the determination of the Brix reading and the polarization. It is pointed out that the error which arises in graduating a Brix spindle certainly constitutes a systematic error of a certain dimension during the whole of the time it is in use; but, since hydrometers are easily often broken in the hands of assistants, this error can really be regarded as an accidental one. Actually, therefore, the average error due to hydrometer calibration works out at a lower value than may generally be assumed. An error is due also to a less extent to reading the hydrometer and reading the thermometer. In making the polarization, errors may arise from the normal weights, the counterpoised dish, the weighing out of the sample, the 100 c.c. flasks (calibrated at 20°/4°C.), the temperature of polarization (if not 20°C.), and finally from the saccharimeter itself and its reading (other errors inherent to the analysis such as that arising from the volume of the lead precipitate or the effect of the lead clarifier on the levulose rotation not being considered). Calculating these various errors it is estimated that the final average error in determining the apparent purity may be 0·28 to 0·33; these being the sum of the probable relative errors of the several observations. An important source of error arises in making up the contents of the 100 c.c. flask for polarization, and the attention of assistants should be compelled to the mixing of the solution previous to making up to the mark (owing to the phenomenon of contraction so marked with sugar solutions), and also to the temperature at which this adjustment is made.

REPORT OF THE NEW YORK SUGAR TRADE LABORATORY FOR THE YEAR ENDING DECEMBER 31ST, 1925 (AVERAGE POLARIZATION OF CUBAN, PORTO RICAN, PHILIPPINE AND OTHER RAW SUGARS; VALUE OF THE 100° POINT OF THE SACCHARIMETER). *F. W. Zerban. New York Sugar Trade Laboratory, Inc., 80, South-St., New York, U.S.A.*

Dr. ZERBAN reports that the total number of samples tested by the Laboratory during 1925 was 21,707, an increase over the previous year, these samples representing an average of 1721 bags each, against 1579 in 1924, and 1650 in 1923. Philippine centrifugal sugars, which now have entirely superseded the mat sugars of former years, generally average higher in polarization than the other sugars imported into the United States. During the summer months of 1925, importations from the Philippines were at times so heavy that average monthly polarizations were no more indicative of the average polarization of Cuban and Porto Rican sugars, which formerly comprised all but a small percentage of the importations. Dr. ZERBAN was, therefore, instructed to ascertain monthly average polarizations separately for Cuba, Porto Rico, Philippines, and "miscellaneous" (Santo Domingo, British West Indies, etc.). The average for the year for the countries in the order named being 96·03, 96·22, 96·80, and 95·82. Average polarization of all samples tested was 96·11, again slightly higher than last year, that for Cuban sugars alone being 96·03. Percentage of samples testing between 96 and 97° has risen to 58·65, compared to 55·35 in 1924; and that of sugars between 96 and 95° has fallen to 26·47, against 28·66 in 1924, which was the lowest on record up to that time. During the year under review the question of the saccharimeter standard used in the Laboratory again arose. A circular letter was therefore sent out to all the prominent sugar laboratories throughout the world; the replies received showed that nearly all, like the N.Y. Sugar Trade Laboratory, prefer to adhere to the Herzfeld-Schönrock value of the hundred point of the saccharimeter until another figure is agreed to internationally.

Review of Current Technical Literature.

VAPOUR COMPRESSION EVAPORATION *A. J. V. Underwood. The Chemical Trade Journal, 1926, 78, No. 2020, 153-154.*

Compression of vapour, so as to raise its temperature and establish a temperature difference that will enable it to give up its latent heat, and thus effect further evaporation, can be effected mechanically, or by means of injector action, using "steam compressors." If cheap power is available, while fuel is comparatively dear, a motor-driven compressor is clearly indicated and the vapour compression method of evaporation offers very great advantages in comparison with steam-heated multiple effect evaporators. Vapour compression methods, using mechanical compression, are also particularly applicable when power is generated by means of internal combustion engines where exhaust steam from a steam-power plant is not available for evaporation processes unless it is generated in waste heat boilers. Under these conditions the high thermal efficiency of the internal combustion engine, in comparison with that of the steam engine, makes this particular combination a very economical one especially if the heat of the exhaust gases is utilized in addition. In view of the comparatively low degree of compression required for the vapour compression system, the rotary compressor possesses the advantages of compactness and ease of operation in comparison with the reciprocating compressor. The efficiency of the rotary compressor is, however, considerably lower being only 60 per cent. compared with 80 per cent. for a reciprocating compressor, and consequently more power is needed when the former type is used. Modern vapour compression systems have utilized both mechanical and steam jet compression. The best known of the former type are the Soderlund-Boberg[1] and Kummler-Matter[2] evaporators, while the steam jet compressor has been most highly developed by PRACHE and BOUILLON[3] The Soderlund-Boberg evaporator aims at high efficiency by keeping the power consumption of the compressor as low as possible and working with a small degree of compression and a very small temperature difference between the compressed steam and the boiling liquid. the maximum specified being 3° C. (0·1 atmos.). It is evident that unless the coefficient of heat transmission is high in such an apparatus, a very large heating surface will be needed, and the capital cost of the plant will be excessive. Regarding the Prache and Bouillon compressor, the commercial utility of this type of apparatus depends very largely on the efficiency of the jet compressor which again is chiefly determined by the design of the nozzle. That designed for use with the Prache and Bouillon evaporator, will entrain and compress 1·75 lbs. of vapour with a consumption of only 1 lb. of live steam.

ACCURATE DETERMINATION OF REDUCING SUGARS (INVERT SUGAR) VOLUMETRICALLY IN THE PRESENCE OF AN EXCESS OF SUCROSE. *N. Schoorl. Archief, 1925, 33, No. 13, 273-278*

An article published some months back by VAN DEN HOUT, NEBTESON, and VAN SCHERPENBERG[4] convinces the author that a practical, routine method of determination having an accuracy of 0·01 per cent. is really to be desired for the control of the reducing sugars or invert sugar in the factory or refinery. But, since Fehling's solution is insufficiently sensitive, he selects Stanley-Benedict's modification of Luff's reagent,[5] which is prepared from 17·3 grms. of cupric sulphate, 115 grms. of citric acid, and 500 grms. of sodium carbonate per litre. This solution, which must of course be perfectly clear gives very constant results in the presence of an excess of sucrose (which has a certain, reducing power of its own, for which in the analysis of high polarizing sugars an allowance must be made). Into a 300 c c. Erlenmeyer flask, 25 c.c. of the modified Luff's reagent is pipetted, this being followed by the sugar solution under examination, and also by water to make up the volume to 50 c.c. A few pieces of pumice having been added, the liquid is heated to boiling in 3 min., and maintained in ebullition for exactly 5 min., the flask having been connected with a reflux condenser or at least with a long cooling tube to maintain the same volume. At the end of the time stated, the contents of the flask are cooled to room temperature, 3 grms. of potassium iodide added, and directly after 25 c.c. of 25 per cent. sulphuric acid, this latter being poured in carefully to avoid violent effervescence. Lastly, the liquid is titrated with N/10 thiosulphate in the usual manner using starch solution. A "blank" or control test is made under precisely parallel conditions, excepting that in place of the assay solution, a solution containing the same amount of sucrose as is present therein is used. Theoretically this should require 17·3 c.c. of thio. Then having ascertained the difference between the assay and the blank titrations, the mgrms. of invert sugar are read from the following table; and, knowing the concentration of the assay liquid, the percentage result is calculated:

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[1] For example, U.S.P., 1,150,713 ; *I.S.J.*, 1916, 195 [2] For example, U K.P , 123,716 , *I.S.J* , 1920, 58 [3] For example, U K.P., 25,458 of 1912 , *I.S.J.*, 1913, 344.
[4] *Chem Weekblad*, 1924, 21, 578 582. [5] *Jl. biol. Chem* , 1909, 5, 485.

N/10 THIO C.C.	INVERT SUGAR MGRMS.	N/10 THIO C.C.	INVERT SUGAR MGRMS
1	3·0	10	29·6
2	5·9	11	32·7
3	8·8	12	35·8
4	11·8	13	38·9
5	14·7	14	42·0
6	17·7	15	45·2
7	20·6	16	48·4
8	23·6	17	51·6
9	26·6	—	—

It was found that 10 grms. of sucrose gave in 5 min. a reduction corresponding to 0·33 c.c. of thio, that is, as much as 1 mgrm. of invert sugar, though it was also noticed that the reducing power of invert sugar is increased somewhat by the simultaneous presence of sucrose, 1 mgrm. then corresponding to 0·40 c.c. of thio. Working with pure sucrose, purified according to KRAISY[1] the reduction found was equivalent to 0·33 c.c.; hat of highly refined Dutch crystals, the same; that of refined about two years old,) 2·30 c.c., so that deducting 0·33 c.c., one finds 0·05 per cent. of invert sugar to be present in it. In ordinary good refined the invert sugar was found to average 0·002 per cent. Such precise results could hardly have been obtained with Fehling's solution. Therefore a method such as this, offered for routine operation in the white sugar factory or the refinery, is worth the careful consideration of the chemist.[2]

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NEW REGULATIONS IN THE UNITED KINGDOM IN REGARD TO THE DENATURING OF METHYLATED SPIRITS. *H.M. Board of Customs and Excise, London.*

New regulations as to the denaturing of methylated spirits, which were to come into force on February 1st, are published. It is prescribed that the substance and combinations of substances to be mixed with spirits for the purpose of making the following different kinds of methylated spirits, and the proportions in which such substance and combinations of substances shall respectively be used, shall be as follows:—(1) In the case of Industrial Methylated Spirits, to every 95 parts by volume of spirits, 5 parts by volume of wood naphtha. (2) In the case of Industrial Methylated Spirits (Pyridinized), to every 95 parts by volume of spirits 5 parts by volume of wood naphtha, and also 0·5 part of crude pyridine to every 100 parts of the volume of the mixture. (3) In the case of Mineralized Methylated Spirits, to every 90 parts by volume of spirits 9·5 parts by volume of wood naphtha and 0·5 part of crude pyridine, and to every 100 gallons of the mixture 0·375 of a gallon of mineral naphtha or petroleum oil and not less than 1/40th of an ounce by weight of powdered aniline dye (Methyl Violet). Essential oil or other flavouring matter must not, without the express sanction of the Commissioners, be added to or mixed with methylated spirits.

CHAR *vs.* CARBONS. Franz Nosek. *Zeitsch. Zuckerind. Czechoslov., 1925, 50, No. 12, 93-96.* Polemical to some extent. Dealing with beet liquors, a curve was constructed illustrating that with 1 per cent. of carbon a decolorization of 40 per cent. was obtained, but that with 2½ per cent. one only a little more than 40 per cent. Only when revivification can be performed cheaply is it practicable to use more carbon. Writing of cane liquors it is said that "the products boiled from these did not show the same quality as our (beet sugars, since the crystals growing in a non-alkaline medium adsorbed part of the colouring matter which had remained"—PRODUCTION OF HYDROGEN FROM SUGARS, STARCH OR CELLULOSE. *A. C Thaysen. Chemistry and Industry, January 8th, 1926, p. 71.* "To-day the production of butyl alcohol (with hydrogen and acetone as by-products) is a flourishing industry in countries where cheap raw materials are available in the form of starch and sugar." This is effected by a bacterium of the *Amylobacter* group.—THE RUSSIAN BEET SUGAR INDUSTRY UNDER THE SOVIET (DURING 1923-25). *M. Kulescha. Archief, 1925, 33, No. 50, 1353-1370.* Figures are given for: Capacities of the factories; beets sliced, compared with pre-war quantities; fuel consumption; sugar per hectare; etc., etc. Russia's tons per hectare during the past three years have been 1·33, that is just one-third of the figure for Germany.—ACCURACY OF GRADUATED MEASURING VESSELS. *H. V. Renn.*[1] *The Industrial Chemist, 1925, 1, No. 11, 515; 1926, 2, No. 30-34.* Very useful practical information is given respecting: Standard temperature; choice of glass: testing of the flask, cylinder, burette, and pipette. Unit "ml." has now almost entirely replaced the "c.c." for vessels submitted to the N. P. L. for test, and some dealers in laboratory apparatus are abandoning the former method of calibration.—JELLY STRENGTH OF PECTIN JELS. *Geo. L. Baker. Industrial and Engineering Chemistry, 1926, 18, No. 1, 89-93.* Studies optimum concentrations of sugar, acid and pectin for the greatest "strength," also factors such as the time of boiling, temperature and the age, these tests being made by means of a "jelly tester" here described.—TESTING THE QUALITY OF FILTER-CLOTH FOR USE IN THE BEET FACTORY. *Jaroslav Hruda. Zeitsch. Zuckerind. Cecho-slov., 1925, 50, 73-80, 81-87, 89-93, 113-118, 121-128.* A long series of tests with different cloths for dressing the presses used for the filtration of first carbonatation juices showed marked differences, especially in durability, and two marks were found to give particularly good results.—PREPARATION OF ASH-FREE CHARCOAL. *L. H. Reyerson. Industrial and Engineering Chemistry, 1925, 17, No. 11, 1114.* Laboratory experiments indicated that by extracting cocoanut shells with ether, alcohol, and water successively and carbonizing a charcoal containing only 0·4 per cent. of ash can be obtained, silicon being the only ion present, whereas a sample of "Dorsite" decolorizing carbon showed 2·45 per cent. of ash containing sodium, potassium, carbonate, sulphate, and phosphate.—COMMERCIAL MANUFACTURE OF PECTIN. *William A. Rooker. Fruit Products Journal;* through *American Vinegar Industry, 1925, 5, No. 1, 10-11, 18.* Sources of pectin for the manufacture of pectin syrup and powdered pectin are here discussed—COLORATION OF BEET JUICE IN EVAPORATION. *C. Tschaskalik. Centr. Zuckerind., 1925, 33, 374-376, 475-476 H A. Schlosser. Ibid., 504-508. W. Köthe. Ibid., 531-534. C. Tschaskalik. Ibid., 560-563.* Nett conclusions of these experimental data are that it is definitely established that the evaporator working under pressure does not cause more colour than in ordinary operation under vacuum, in fact may give rise to less, when a good circulation is ensured. These data are even more favourable than those of LINSBAUER and FISER[2] towards "pressure evaporation."—ACTIVE (DECOLORIZING) CARBONS. *O. Ruff. Zeitsch. angew. Chem., 1925., 38, 1164-1169.* Elementary analysis has failed to indicate any clue to activity, but active carbons are always denser than inactive charcoals. Carbons to be capable of activation must be amorphous; and heating to too high a temperature (e.g., over 1100°C.) destroys its activity and also the capacity for activation. Active amorphous carbon probably contains irregular groups of carbon atoms with valencies incompletely satisfied, and where these lie on or near the surface of the pores of the charcoal they act as centres of adsorptive attraction. In inactive carbons the amorphous substratum is covered with a dense skin of saturated carbon atoms, and the object of the activation is to remove or break through the skin. Activation consists essentially in etching or partially breaking up the surface. J.P.O.

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[1] *I.S.J.*, 1922, 156. [2] Consult *I.S.J.*, 1921, 347-348.

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[1] Fromerly Chief of Laboratory Staff, to DUROGLASS, LTD, chemical glassware manufacturers.

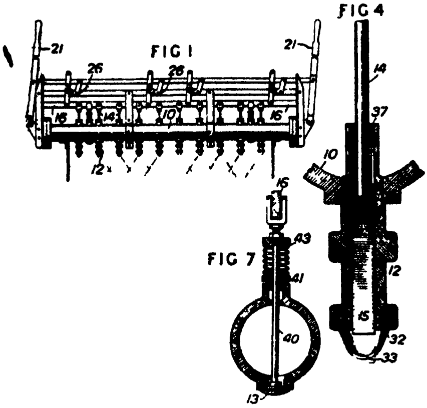
[2] *I.S.J.*, 1925, 53.

Review of Recent Patents.[1]

UNITED KINGDOM.

Spraying Apparatus for Cane Maceration.* ***Robert W. Sharp***, of Baton Rouge, La., U.S A. *236,028*. June 11th, 1924.

The apparatus comprises an elongated manifold extending over a body of bagasse to be treated, a series of spraying nozzles connected with the said manifold and having laterally elongated outlet orifices, cleaners within said nozzles for clearing their orifices when necessary, and means for simultaneously operating said cleaners. One object of the invention is to provide in a saturating or macerating machine having a series of discharge nozzles for the water or juice, conveniently operated means for efficiently and quickly cleaning the orifices of said nozzles, thereby ensuring a proper flow through the same and the perfect saturation of the bagasse. A further object is to provide a saturating or macerating machine of reliable and durable character throughout and composed of easily assembled parts, and one capable of being readily positioned for use and conveniently operated. In carrying out the invention a manifold or pipe of adequate capacity and suitable length is employed, connected with a source of supply of water or juice, or a mixture of both, under pressure, a series of discharge nozzles extending from the lower side of said manifold adapted to deliver the water or liquid in the form of a broad complete sheet against the width of the blanket of bagasse travelling from one set of rollers of the mill to another set of rollers for further treatment, blades within the nozzles for cleaning the outlet orifices thereof and means for simultaneously operating all of said blades, the features mentioned being of special construction and arrangement rendering the machine highly efficient. Referring to the drawing in illustration of the invention, an apparatus is shown comprising an elongated pipe *10*, connected with the liquid supply, provided with a series of spraying nozzles *12*, Figs 1 and 4, having elongated outlet orifices, each of which is provided with a cleaning blade *15* attached to a rod *14*, the rods being capable of simultaneous operation by means of a bar *16* actuated through bell cranks *26* by handles *21*. The nozzles are formed of tubes *12* extending into the pipe *10* having grooves *37* within which the blades *15* slide and provided with removable cup-shaped tips *32* provided with segmental slots *33* so arranged that the liquid from the tips coalesces to form a sheet. In addition to the spray nozzles, the pipe *10* may be provided with flushing valves *13*, Fig. 7, secured to rods *40* passing through stuffing boxes *41* and normally held closed by springs *43*, but which may be opened when the bar *16* is depressed.



Preparation of Active (Decolorizing) Carbon.* (*A*) ***J. N. A. Sauer***, of 2, den Texstraat, Amsterdam, Holland. *239,694*. September 3rd, 1924. (*B*) ***J. H. Brégeat***, of 24 rue de la Fidélité, Paris. *239,744*. December 6th, 1924.

(*A*) Activated carbon for purifying and sterilizing liquids and gases is prepared from fibrous carbonized material of vegetable origin, preferably of low ash content and without inorganic admixtures, by heating it in an activating gas wherein it is maintained in a state of flotation, suspension, or movement by mechanical means or by a blast of gas,

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C 2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D C (price 10 cents each. *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin Germany.

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Notes and Comments.

The British Sugar Beet Society: Annual Meeting.

The 11th annual meeting of the British Sugar Beet Society took place in April under the Presidency of Mr. G. H. ROBERTS, chairman of the Committee of Management. In his speech on the work of the year he said that Parliament was watching the development of the industry with keen interest, and it was a matter for satisfaction that they had succeeded in lifting the industry above mere party considerations

The year 1925 started with three factories in operation, but by the end of that year the number had increased to ten; and during 1926 at least six further factories are expected to be in operation, including those projected at Felstead (Essex), Poppleton (York), Cupar (Fife), and Peterborough; the Yeovil project of the Anglo-Dutch group is reported to be in abeyance, the promoters having secured alternate sites at Didcot (Oxfordshire), Savernake (Wilts), and Pulborough (Sussex), which they will proceed to utilize providing the necessary acreage of beets can be guaranteed.

At the luncheon given by the Society, Mr. GUINNESS, the Minister for Agriculture, said that the industry was a very healthy child, and the response of the farmers and their realization of the advantages of the new industry had been most gratifying. He considered that nothing less than what the State had offered the industry in the way of a subsidy would have achieved their object. As for the results, he hoped it would not be long before we attained the Continental standard of 10 tons average yield per acre. In 1925 we managed 8·1 tons. But the factories would have to do everything they could in the years of subsidy to reduce costs of production and to write down their capital, so that when the ten-year period came to an end they might stand a chance to compete with the output of Continental factories that were for the most part capitalized on a lower pre-war basis.

British factories, he pointed out, had financial support from Holland, Hungary, and the U.S.A.; and received technical support not only from those countries but also from Czecho-Slovakia and Canada. We had got the advantage of about 38 per cent. of foreign capital invested in our sugar industry; although this fact was criticized in certain quarters he, personally, welcomed it, because if we wanted to increase our exports there was no better way of doing it than by getting foreigners to put their money in this country and take out interest in the form of the purchase of British goods. Sugar beet, he concluded, was going to be invaluable in the present difficult situation of arable farming.

Cost Averages in the Home Beet Industry.

In one of his recent speeches on behalf of the British Sugar Beet Society, Mr. ALFRED WOOD, the secretary, took the opportunity to deal with recent criticisms on the economics of the beet sugar industry in this country. He declared that there had been attempts on the part of people not engaged in this new industry to persuade the farmer that the present beet prices are less than the factories can afford under existing conditions; but that this was a case of intervention of opponents of the industry rather than of friends of the farmer. He also complained that while the most successful factory is often used as a guide on the manufacturing side, the least favourable results of cultivation are taken as a guide on the growing side. Thus he criticised the recent report issued by Oxford University (to which reference was made in our February issue[1]) as a case in point. In that report the average cost per acre was given as £21 12s. 4d. and per ton 42s. 4d. The average return less cost of transport was £23 7s. 7d. per acre and per ton 45s. 9d. The average profit was therefore £1 15s. 3d. per acre or 3s. 5d. per ton. The average yield was 10·20 tons per acre and the average sugar content in the beet 16·6 per cent. As contrasted with these figures, Mr. WOOD adduced results from four well-managed farms in East Anglia where the cost per acre worked out at £16 3s. 11d. or 27s. 10d. per ton; the return less transport was £28 13s. 8d. per acre or 49s. 2d. per ton; the profit was £12 9s. 9d. per acre or 21s. 4d. per ton; the average sugar content was 16·2 per cent.; and the average tonnage per acre was 11·61 tons. These figures clearly demonstrate the wide divergence in the results of different farmers, and suggest that as the experience of the less successful growers increases their returns will approximate more nearly to those of the best, and will allow each successive fall in the rate of the subsidy to be met.

Incidentally, Mr. WOOD warned his hearers that when the balance sheets of the nine factories that operated in 1925 are issued, they are not likely all to disclose successful results. As in the case of the farmers' crops there will be considerable divergences in results and some of the newly-built factories may show no profit. Any attempt to judge the industry on the factory side by the figures of the most mature factories is bound to lead to disappointment. But what other countries have done with a State-aided period of fifty years the home industry is laying itself out to do in ten; it has the advantage of absorbing the knowledge gained by continental countries as the result of their longer experience, and the help of at least five foreign beet growing countries has been secured with their varied experience and expert technical knowledge.

The West Indian Agricultural Conference in Jamaica.

The Proceedings of the ninth West Indian Agricultural Conference, held at Jamaica in January, 1924, appear to be somewhat belated in their appearance, and have only just been received. Doubtless there may be sufficient reasons for this delay; but, with the rapid developments taking place in tropical agriculture at the present time, most of the papers on the sugar cane, with which we are chiefly concerned, are already a little out of date. This is not altogether fair to the writers of the papers. The latter are, all of them, useful; and, even now, will repay a careful perusal by outside students. The Mosaic disease is, of course, to the fore; but perhaps this subject suffers more than any other by the lapse of the two years. The chief value of Mr. HANSFORD's paper lies in the light thrown upon the origin and progress of this disease in Jamaica : the careful study of any disease in one locality, with its peculiar set of conditions, is of permanent value in "sizing up" its general importance. In the discussion, Professor ASHBY gives an account of the appearance of the disease in St. Kitts, Nevis and Antigua, which is useful historically. The position in Barbados appears to be somewhat mysterious, for Mr. BOVELL roundly declares that he has little knowledge of the disease "as we do not have it." This may be a case of remarkable recovery, for it is referred to as "practically all over the island" in 1922;[1] and, if so, Mr. BOVELL would know a good deal about it. In a paper Professor ASHBY gives concise accounts of Gumming Fiji disease and Leaf Stripe, all of which are serious and, although not yet met with in British West Indies, must be watched for : gumming is already present in Porto Rico. This paper was characterized by the Chairman, Sir FRANCIS WATTS, as a "powerful warning." The Botanical Notes on the Sugar Cane by Professor HARLAND are interesting enough to receive separate attention in another part of this number of the Journal. Mr. BOVELL, perhaps somewhat unnecessarily, defends the work of the Agricultural Department in Barbados, by working out the apparent financial gain obtained by the introduction of two or three new seedling canes into the fields. The cane sugar world is well aware of its debt to Barbados in the production of seedling canes. The past sugar cane experiments in Jamaica and Trinidad are dealt with by Messrs. MURRAY and VERTEUIL respectively, and these handy summaries will be doubtless of use for reference.

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[1] Page 73.

American Sugar Refining Co.'s Annual Report.

According to the annual report of the American Sugar Refining Company just issued, the year 1925 was again an unfavourable one in the sugar industry, and profits were once more inadequate for both producers and refiners. It was, however, the one year in the last three in which the Company made a profit on its refining operations. In 1925 they refined 1,307,622 tons at a profit of $4,477,143 (or about one-seventh of a cent. per lb.) in contrast with 1,162,622 tons in 1924 at a loss of $327,637, and 1,162,000 tons in 1923 at a loss of $1,693,070. The total income of the Company for the year from all sources aggregated $7,477,657.

The year not only witnessed a generally anticipated increase in production, but there was also a nearer approach to stable prices, and this afforded a more favourable opportunity for refining profits. For the third successive year there were 115 changes in the price of raw sugar, yet the extreme fluctuation was only 1·125 cents per lb. as against one of 2·8125 in 1924 and 3·375 in 1923.

During the year under review exports of refined sugar to the amount of 338,713 long tons were made from the U.S.A. to 72 foreign countries, of which 50 per cent. was turned out by the "American." Of this quantity 167 134 tons went to the United Kingdom, 30,239 tons to Uruguay, 20,225 tons to Norway, and 15,866 tons to Russia. The rest went in smaller quantities to various other destinations.

The "American's" profits came not only from refining but also from cooperage, molasses, and shipping operations. Interest from investments—largely from the Company's Cuban properties—brought in nearly three million dollars.

Expenditure for maintenance and repairs amounted to $38,300,000. Throughout the refineries there was replacement of a vast amount of machinery and equipment of antiquated design and inefficient character; the establishment of all refineries on continuous char filtration; substitution of modern mechanical filters for bag-filters. At the Boston refinery new centrifugals, evaporators, vacuum pans have replaced obsolete equipment; the boiler-house has also been thoroughly overhauled, a new stoker equipment being installed, and steam may now be generated either with coal or oil, according to the state of the fuel market. At the Philadelphia refinery, the boiler-house has also been completely rebuilt and large boiler units have been installed capable of burning either pulverized coal or oil. The Chalmette refinery has been electrified practically throughout; much of the older equipment has been replaced, and special arrangements have been devised for efficiently dealing with the molasses and the production of canned syrups. The most forward step, however, in the Company's programme has been the building of the new refinery at Baltimore, which has met the fullest expectations. This step has allowed the Company to close its old refinery at Jersey City and sell the property. Brooklyn refinery is being gradually rebuilt, as opportunity offers and sites can be secured.

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[1] *I.S.J.*, 1923, p. 541.

Based on 1925 meltings, the Company produced about 13 per cent. of its raw sugar requirements on its plantations, Centrals Cunagua and Jaronu. Cunagua completed its eighth campaign, and Jaronu its fourth campaign in May, 1925. The former produced 601,031 bags and Jaronu 593,509 bags of raw sugar of 325 lbs. each. The joint production of final molasses amounted to 10,671,824 gallons. These centrals are really one plantation with two raw sugar factories upon what was once an unbroken plain of virgin forest land of about 500 sq. miles, now served by about 180 miles of railroad, with the two raw sugar factories so located as to provide economical handling of cane. The construction of this plantation was a pioneer effort of a larger character than ever attempted before in the sugar world in a similar period of time. The unbroken forest has already been cleared to the extent of over 150 sq. miles and brought under cultivation to sustain the annual crop of cane necessary for the production of 1,200,000 to 1,400,000 bags of raw sugar. The factories, railroads, and agricultural development have been established under the direction of a most capable and experienced Cuban organization, and an efficiency and low cost operation obtained which, it is claimed, is not excelled at any other point in Cuba.

A German Sugar Combine.

According to a Department of Overseas Report the *Berliner Tageblatt* announces that 250 German firms (out of a total of 298 sugar factories in Germany) have agreed to join the "Ausfuhrvereinigung der Deutschen Rubenzuckervereinigung G.m.b.H.," which has decided to finance a scheme for the export of about 10 per cent. of the German production, i.e., 200,000 tons. A central export department is not to be organized, but it will be left to individual producers to sell from their stocks, though provision will be made to avoid such competition among German sellers in foreign markets as would be likely to influence prices. The inland prices will be regulated according to world market rates plus the German duty on sugar as a maximum. The scheme is to be adopted on account of the difficult situation of part of the sugar industry, who have no prospects of disposing of all their stocks on the home market and are incurring great losses through storage of surplus quantities. England is regarded as the principal customer for this surplus sugar, since her new industry is unable to supply but a small fraction of her requirements, although it is realized that preferential customs treatment for Colonial produce presents a formidable obstacle.

Fifty Years Ago.

From the "Sugar Cane," April, 1876.

It is of interest to give a few extracts from this number of our predecessor, in order to show the state of development of the science of sugar manufacture in certain of its aspects. These concern the use of megass or bagasse; the extraction of juice by diffusion; and clarification by the carbonatation process in Java, "fifty years ago."

"The unsatisfactory nature of this season's sugar crop [in Queensland] renders any suggestion calculated to effect an improvement in the economical working of our sugar factories worthy of very serious consideration; and, as the advantage or otherwise of firing steam boilers by means of megass is still a moot point amongst those engaged in the manufacture of sugar, it is desirable to direct attention to so important a matter. . . . . . If the consumption of straw and such like fuel is worthy of serious consideration where coal is very much cheaper than in this colony, the employment of megass for the firing of steam-boilers ought to effect a very great saving, as every season's consumption renders the obtaining of a supply of firewood a more difficult and expensive matter."

Excerpts may now be made from a report by LUDWIG KOLLMANN on the Robert process for extracting juice from cane by diffusion, at that time being tried out at the Belle Alliance Plantation, in Louisiana:—"Taking advantage of this difference of osmotic power, our process is conducted in such a way as to extract rapidly the greatest possible amount of sugar, and to leave in our residue the greatest possible amount of albumen, and thus secure a juice much richer in crystalloids and poorer in colloids than any juice which can possibly be obtained by grinding cane between rollers . . . . . Consequently, the complete extraction of the sugar from the cells can only be accomplished by fractional diffusion, that is, by replacing the liquid obtained by another of less specific gravity (or by water), and this manipulation must be continued until the desired exhaustion is reached . . . . . Diffusion is the extraction of juice through closed or unopened cells. Maceration is the extraction of juice from opened or lacerated cells. The very definition shows the superiority of the first over the second method. As before shown, but a small fraction of the impurities of cane juice are held in solution by the diffusion. In maceration the sugar cells are nearly all violently ruptured, and not only do all the impurities in solution come with the juice, but also large quantities of mechanical impurities. The juice must be more impure even than that of the mill, because in the former the impurities in the rind of the cane are reduced to powder, and are to a great extent washed out with the liquids. Maceration juice is therefore much more difficult to clarify, and in the manufacture of sugar from beet had never been generally adopted, even when diffusion was not known. . . . . ."

Then from another source: "The process of double carbonatation is about to be tried in Java, while it is also, we believe, applied to refining purposes by one of our out-port refiners. Apart from the double carbonatation process, the cane sugar planters might probably adopt with advantage some modification of the filter-presses universally used for beetroot, instead of boiling up so many impurities with the juice, and removing them by the obsolete system of skimming."

The Scientific Study of the Sugar Cane.

An interesting though very brief paper by HARLAND, in the Proceedings of the West Indian Agricultural Conference held at Jamaica in January, 1924, appears to be worthy of some comment.[1] In it, the author gives his impressions as to the problems facing him in the study of a new crop in the tropics, namely that of the sugar cane. It would be unfair to expect either a thorough knowledge of the plant itself or of the extensive literature which has accumulated around it, and his paper is to be taken rather as suggestive than as the considered opinion of one who has long studied the sugar cane. It is not altogether surprising perhaps that the general attitude of the author towards former work shows a somewhat scant courtesy if not actual condemnation; for he has at his disposal an equipment very different in certain respects from that of practically anyone who has studied the sugar cane before, with the possible exception of the long line of workers on the crop in Java. It may not be generally known what a thorough training is given to all colonial technical candidates at the great Agricultural University at Wageningen in Holland. After a preliminary year on agricultural science, three more are definitely extended to the treatment of purely colonial crops; and it is certain, from the syllabus, that breeding work takes a prominent place in the curriculum. The result is seen in the excellence of much of the scientific work on sugar cane which has emanated from Java.

As regards research work in the parts of the tropics under British influence, very few trained biologists have, until quite recently, been allowed to devote themselves to one crop only and, even then, restrictions as to their line of work have been imposed, and usually a large amount of purely administrative work has been added, greatly handicapping output. This would never be allowed in a research institute such as the new Imperial College of Tropical Agriculture in Trinidad. And it is thus with peculiar satisfaction that the writer of this article gathers from HARLAND's paper that it is the intention of the biologists gathered together in Trinidad to attack the sugar cane along up-to-date biometric lines. Another great advantage which they will enjoy in any study of the sugar cane will be the possession of a comparatively comprehensive library, although it is certain that no library could contain all that has been written about the sugar cane. Much of the latter is of little immediate value, but here and there are papers which should be of great use. A good library has not been available in the great majority of cases for previous workers in the British colonies.

It has all along been felt peculiarly desirable that the sugar cane should be submitted to a thorough Mendelian examination; but, for certain intrinsic reasons, progress along this line from the crop point of view is bound to be very slow. With a crop vegetatively reproduced, the first cross has been the initial aim in breeding work; as this could be indefinitely reproduced without losing its characters for a considerable period. After the seven or more years necessary for testing its various values, vigour, habit, ratooning power, richness of juice and milling qualities, such a first cross can with some confidence be released for general cultivation. It is true that new varieties have been distributed sooner than this; but such undue haste has been necessitated by urgent economic reasons, and the results have often been unsatisfactory in the long run.

In the programme suggested by HARLAND, it is natural that the success which has been obtained by the application of biometric methods to the study of the cotton plant should have its influence; but the sugar cane will have to be approached along different lines. It has always seemed to the writer to be more natural that, in studying a plant which will never be propagated by seed for crop purposes, the work done on the potato should be more closely followed. For the rest, a moment's anxiety was caused on reading that "attention will be concentrated at present on lines of work immediately profitable from the economic point of view;" but perhaps former workers on this crop are a little sensitive upon this point, as the necessity for quick results has perpetually interfered with their line of research.

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[1] The report of these Proceedings appears to have been a long time in the press. It has only been received very recently.

A few remarks may be made on HARLAND's discussion of his three lines of study, morphology, physiology, and genetics. Under morphology he only deals with classification. This according to the usual method adopted among plants, has been based upon the external and internal structural features of the variety: in the sugar cane with certain physiological and eclogical characters added. For such work, on plants under cultivation, a great deal of intimate knowledge is a pre-requisite. To obtain the knowledge required is of course an unending labour; but the greater the labour expended, the more certain is the possibility of detecting the real affinites of the plants. A striking illustration is afforded by the review of the various schemes of classification propounded from the somewhat crude commencement by LINNAEUS to the natural classifications of to-day. Any attempt to introduce Mendelian principles is bound at first to be somewhat destructive of these classifications, unless handled with the greatest judgment: in case this is not exercised a great deal of confusion will certainly result in place of a useful clearing out of errors. But this danger is less to be feared with regard to the sugar cane, in that at best the present systems, if they may be called so, are as everyone allows very unsatisfactory; and any new light will be most heartily welcomed. Such work must, however, at first be based on a very sound knowledge of the morphology and anatomy of the cane; and any real knowledge on these subjects has only very recently been obtained. The results thus far recorded on Indian canes, very incomplete it is true, have proved of distinct value; but it is very doubtful whether any similar classification can be traced in the tropical forms which, at present, appear to be more comparable with one of the great Indian classes established. It has been frequently lamented by the writer that the great collections brought together in former years have been dispersed, without the needed morphological study; and this will hamper any future attempts in this direction.

One line of work which may be expected to throw a good deal of light on the difficult question of classification is that of a cytological examination of different varieties: down to and including the north Indian forms, and even *Saccharum spontaneum* which is regarded as, at any rate, closely allied to the primitive stock from which the Indian forms have been derived. Information to hand seems to indicate that the results of such an examination are likely to serve as a useful aid in classification, although the numbers of chromosomes are so large that it seems desirable that the work done in Java should be checked.

There is a great field for the development of our knowledge of the morphology and anatomy of the cane plant. Sporadic papers continue to appear, chiefly on anatomy; but there is still room for careful comparative studies under the microscope, to bring out essential differences in the structure of the leaf, stem and root. This cannot be neglected in any thorough system of classification, or indeed in any ecological study of the plant. But, from a practical point of view a limit must be placed on such work. Even as to external differences, the writer investigated over one hundred characters among the Indian canes, some of which he found to be common to all the forms of a class, while others were only found to be shared by a few forms. And he came to the conclusion that the longer the time spent in such work, the greater the number of characters of systematic value that could be obtained. The work of JESWIET[1] in Java, of determining varieties by the arrangement of hairs on the scaly buds of tropical canes, is a good illustration of the extreme labour which may be involved in such work: there can be little doubt that in certain cases this method has been and will be of value in clearing up doubtful points. Without a sound basis of morphological knowledge the use of biometric methods is not likely to be of much value, but the two proceeding together should lead to a sounder system of classification.

The physiological study of the cane plant has proceeded much further than the purely morphological, thanks to a considerable number of valuable papers which have been published from time to time in Java: these will doubtless be available in the College library. It is in this section that the biometric methods promised by HARLAND are likely to be of the greatest service in the elucidation of the life history of the sugar cane plant. There is undoubtedly a great amount of work waiting to be done, and when his results have accumulated in sufficient measure for publication they will be eagerly looked for by all interested in this important crop.

But here again, as in all crops in the tropics, a thorough knowledge especially of the anatomy of the different organs of the sugar cane plant will be required. For this line to be of general application, the "sound system" of classification will obviously be of service, because of the known variation in the behaviour of the different kinds of cane to external conditions. These variations should be largely explainable by corresponding ones in the structure of the organs in the different forms. Such studies should throw a great deal of light upon the ecology of the cane plant and its general plasticity. There is of course available a very considerable literature of the climatic variations of the different cane growing countries.

One of the points to be decided will be the unit experimented with. To all appearance, up to a certain time, this might be the whole plant which arises from the development of a single bud of the set; but, at a certain stage, when branching has developed, it would probably be more convenient to concentrate upon one branch only, namely the cane with its tufts of leaves.

In the brief remarks on the third branch of enquiry—genetics—the author appears to the writer to be, perhaps, rather confident. For instance, to compare our existing knowledge of the sugar cane plant with that to be obtained from a dictionary, from which 90 per cent. of the pages have been torn out, will certainly not prove very generally acceptable. A somewhat fuller study of the literature of the subject, will, we feel convinced, lead the author to modify his estimate; and especially the implication that the application of biometric and Mendelian methods will be able to supply the missing parts of such a book.

It is probable that difficulties will be met with, not experienced with the cotton plant; for instance, in the direction of flowering. The writer, having a little spare time, first commenced to study the characters from the Mendelian standpoint. A large number of observations were made, as a preliminary, on crosses between *Saccharum spontaneum* and a thick cane; about 100 seedlings were similarly examined of a cross between a thick cane and *Saccharum Narenga*; and, lastly, a definite cross of economic value was selfed and 200 seedlings were raised. But none of the latter flowered at maturity, while the whole of the Narenga cross, flowering profusely, turned out to be a set of mules in which all the flowers were completely sterile. Further work was then given up, because of the claims of the first cross, as already indicated, and the absence of time to continue other than purely economic and administrative work.

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[1] JESWIET has recently been appointed to a professorship at Wageningen, and the morphological work started in India appears to have ceased.

Considering the time that has elapsed between the reading of this paper and its printing and distribution in the report just received, we sincerely hope that results of the new lines projected will soon begin to bear fruit; and, as stated, we shall welcome any light which has been thrown on the life of the sugar cane plant.

C. A. B.

Entomology in Queensland Cane Fields.

The Annual Report of Mr. E. JARVIS, the Entomologist of the Bureau of Sugar Experiment Stations in Queensland, contains, as usual, many items of interest. The main insect pests at present causing trouble are summarized as follows. Three are especially serious and require immediate and constant attention: *Lepidoderma albohirtum* (a cockchafer injurious in its larval stage and then known as "white grub"), *Rhabdocnemis obscurus* (the weevil borer), and *Mastotermes darwinii* (a termite or "white ant"). Others of less importance, but serious at times and in places, are *Lepidoderma frenchi* and *caudata* and *Pentodon australis* (cockchafers), *Locusta danaensis* (a grasshopper), and *Pragmatiphila truncata* (a moth stem-borer), besides local and occasional attacks of army worms (*Laphygma exempta*) which eat the leaves. As is usual, the report deals chiefly with the first named of the series.

Of the multitude of remedies tested at various periods by the officers of the department against white grub, the following are recommended as well within the reach of the farmers: (1) Destruction of the insects, in the mature form by collecting off the favourite feeding trees, and in the grub stage by hand picking after ploughing. (2) Prevention of egg-laying by injecting paradichlor into the soil, at the same time destroying any young grubs near; this substance is poisonous to animal life while harmless to vegetation. (3) Good agricultural methods: manuring and cultivation so as to promote vigorous root growth and the conservation of moisture, and also to free the ground from weeds and maintain a friable soil to prevent the laying of eggs. The latter method is interesting from the natural history point of view. The cockchafer prefers to lay its eggs in untouched soil with a firm surface, as it can thus obtain a stance for making its preliminary hole for the egg, and the loose earth falls into this hole as fast as it is made.

The author states that there is a distinct increase in the interest displayed by the farmers in the entomological work. This is very satisfactory, considering the close correlation always maintained between the scientific work and practical agriculture. But on reading between the lines there is considerable need for improvement in the application of what the farmers learn to their fields. They have not apparently yet grasped the fundamental fact that, with the white grub, prevention alone is effective: to wait until the action of the grub is seen on the crop is futile, because it is then too late to attempt a cure.

There is however, in the local circumstances, a good deal to be said for this attitude. In any year natural control may be found to have been sufficient. This is clearly brought out in the report. The outstanding factor in this control, as in all insect attacks on plants, is the meteorological conditions. Prolonged drought or excessive wet at critical periods in the life history will destroy the grubs by the million. Experiences gained on this subject during the two previous seasons were discussed in our last review.[1] A further illustration is presented in the set back received by the pest in 1915-16; it is stated that such a meteorological disturbance will have effect over 1000 square miles, and that the white grub in this case did not fully recover till 1919. Parasites and predators are perhaps of equal importance with the climate in checking the grub; the larvae of beetles appear to be the chief among the latter, while a whole host of minor insect forms have been noted as parasitizing the grubs at different stages.

This uncertainity is of course equally applicable even to the experimental plots laid down by the experts. Thus of the three demonstrations arranged during the year of the advantage of fumigating the soil, two were ineffective because of the absence of the white grub in all the plots.

Jarvis notes that the fumigation with carbon bisulphide has been made use of for a number of years, often with striking success when carried out at the correct time; but nevertheless the practice shows signs of gradually decreasing. This may be owing to the dominance of the climatic factors in the two previous years; but he suggests that the absence of suitable appliances may have a good deal to do with it. But this difficulty can hardly be urged by the farmers in the future, in that as the result of experiments it has been demonstrated that one man and one horse can fumigate the soil over 3·4 acres in a day, and it is considered that machine work is decidedly more reliable than that done by hand, which must be a good deal more costly.

The results of one paradichlor demonstration plot which encountered white grub were convincing enough. The plot was located on high, well drained, red volcanic soil near to the Meringa laboratory, where a crop of second ratoon D 1135 was being grown. The injection was decidedly late, namely on February 18. The wet season had already commenced, and 15 in. of rain had fallen during the previous 37 days; it rained again on February 20, and 35 in. fell during the succeeding 41 days. When the plot was inspected, at the beginning of April, practically all of the untreated stools were dead or dying, many being "eaten out of the ground" by the grubs; whereas the treated plot, 136 ft. by 28 ft. in extent, presented seven rows of normal green cane shoots. This somewhat fortuitous result is claimed as being of exceptional interest, as showing that injection of paradichlor can be successfully carried out even in wet weather on well drained soils; after seven weeks of rain, one-third of the injected material remained capable of further protective action. All the same, it is pointed out that the operation should not be delayed until the leaves shade the ground between the rows.

The best time to apply the poison is carefully considered. Obviously, it will depend primarily on the date of the emergence of the beetles. During the past eleven years, this has varied from October to January, but it appears to have occurred principally in December. For control, the most favourable date of emergence is during October and November, as the plants are still small and the ground has only slight moisture. But if emergence takes place early in December, there is still plenty of time during that month and most of January for the ground to be treated before the wet season sets in. With the striking examples of success attending injection with paradichlor during the past three years, it is, however, disappointing to read that "very few growers were inclined to take action during the 1924-25 season, preferring to trust to the intervention of natural enemies." The reason for this attitude has already been discussed. It is, moreover, quite probable that, with the constant tendency to take up a larger area by the individual farmer than he can properly cultivate, the introduction of any added agricultural practice will be unpopular; the farmer will naturally reason that, even if an attack occurs, it will not endanger the whole of his area, or even a large proportion of it.

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[1] *I.S.J.*, 1925, p. 297.

This custom of planting a larger area of sugar cane extensively, rather than a smaller one with greater care, is severely criticized by the Director in his report; and a strong argument is added by a consideration of the best way to control the white grub. JARVIS points out that it has been demonstrated that *Lepidoderma albohirtum* is not primarily a humus feeder, but prefers to feed on the tender roots of the young cane. Making use of this observation, he suggests that, by appropriate cultivation and manuring, the cane plants may be saved, by presenting a mass of such rootlets near the surface for the grubs to feed on; and thus to bring them within reach of destructive cultivation, while the deeper root system may develop and thus obtain the water necessary for the plant's growth: in other words the surface roots are to be used as a trap for the grubs in their young stages. In support of this method, he states that he has noted that "stools surrounded during the critical period of infestation by a dense mass of surface fibrous roots often escape injury, as the grubs will congregate on these young roots, and finish every one before attacking those lower down which supply the moisture for the plant, and being stouter enable the shoots to maintain their erect position." This appears to be a somewhat heroic measure and must severely tax the strength of the plant; but, after all, it is much better than having the plants "eaten out of the ground." Planet Junior implements are recommended, working the soil lightly for a foot from the young plants, at intervals of a few days.

A few paragraphs are devoted to the consideration of the two other cane pests which JARVIS regards as major ones at the present time in the Queensland cane fields.

He thinks that the time has now come when concerted action is needed against the weevil borer (*Rhabdocnemis obscurus*). Thus far remedial measures have been confined to rearing and spreading the parasite *Ceromasia sphenophori*, which appears to be its chief enemy, both by liberating the mature insect and by placing breeding boxes with puparia in the worst affected places. During the year under report 600 mature flies were freed and 2000 puparia were placed in the breeding boxes distributed. Subsequent inspection showed that in several cases puparia were already to be found on the standing canes. Artificial measures suggested are: burning or stripping cane trash, bait traps, collecting the beetles, and the introduction of borer-proof varieties. Little or no response has been made to previous suggestions of putting bait traps in grossly affected areas. There is not much known about the natural enemies of the borer, those mentioned only including rats, ants, and the Metarrhizium fungus.

Mastotermes darwinii is a comparatively new pest, but appears likely to become important because it is spreading widely in North Queensland. It is primarily a timber feeder which swarms at the mating season, and being a weak flier is swept by light breezes on to the neighbouring cane fields. The wings are immediately cast on landing, and thus the fertilized females are unable to leave the fields. Fortunately white ants have a host of enemies, prominent among these being all mandibulate insects. Poison baits appear to be successful, and paradichlor and dehydrated tar are being experimented with.

C. A. B.

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[1] *I.S.J.*, 1926, pp. 144-5.

Modern Steam Generation.

II.

By JOHN D. TROUP, M.I Mech.E.

(*Continued from page 136*).

FEED WATER.

Modern boiler house conditions demand that much closer attention be paid to the condition of the feed water than has been done in the past. At one end of the scale we have practically chemically pure water produced by the evaporator and at the other end we have an endless variety of boiler compounds which are fed into the boiler itself, many of these latter being of very doubtful value. In some of the more recent boiler house installations the whole of the make-up water is treated in evaporators, but the general practice is to use the two principal chemical processes of treating the water prior to use as boiler fuel. These processes call for no comment here as they have been fully dealt with in the technical press. There are several new methods on the market for dealing with the water in the boiler, notably the Filtrator system, and the Contra-Current electrical system. Both of these systems show promise of being important aids to boiler house efficiency when we know a little more about them.

Greater economy is to be effected in the average boiler house by giving more attention to feed water heating by utilizing exhaust steam which is so frequently available. Small non-condensing engines such as are used for driving economizer scrapers, and other duties, should be arranged to deliver their exhaust to pass through feed water heaters and thus return to the boiler the greater part of the original heat of the fuel.

Feed water heating has the additional advantage that it is a convenient means of increasing the temperature of the inlet water to the economizers up to 100°F., so as to do away with the trouble of "sweating," that is condensation of moisture in the flue gases on the bottom part of the tubes, which contains acid from the sulphur in the coal, and thereby causes serious corrosion. This can in nearly every case be entirely obviated by raising the temperature of the feed-water to the neighbourhood of 100°F., and the method sometimes adopted of re-circulating some of the hot water back to the cold inlet water is, on the whole, not so convenient or efficient as the feed heater. The net result of re-circulating water is to lower the efficiency of the economizer to some slight extent, and it also tends to introduce complications, especially if the injector principle is employed, although there is much to be said on both sides. The disadvantage of the feed heater in this connexion is that it is only in operation when the engines are working, so that it is possible through carelessness to fill up the boilers during the week-end through the economizers with cold water, whereas with an automatic injector arrangement this does not happen. However, various methods can be adopted to prevent this, such as the use of a small amount of live steam, for example, and extensive experience with both methods certainly tends to show that of the two, the feed heater is preferable, quite apart, of course, from the thermal economies already mentioned.

Feed heaters are generally constructed on the principle that the exhaust steam passes through a nest of tubes, while the cold water flows over the outside of the tubes, so that the oil in the exhaust steam does not get into the water, the whole arrangement being contained in a cylindrical casing provided with a safety valve and blow-off cock, forming a very convenient adjunct to the efficiency of steam generation.

The question of de-aerating or "degassing" boiler feed-water is becoming a matter of the greatest importance in view of the enormous size of modern super-power station boilers. Only a few years ago the largest boilers in operation were 50,000 lbs. of water per hour, but to-day the American standard size is rapidly becoming 300,000 lbs. per hour on normal evaporation, and boilers of 400,000 lbs. are under consideration, although in Great Britain the largest boilers we have are so far 100,000 lbs. Evaporations of this character are so enormous in comparison with the weight of the metal in the boiler that the amount of the dissolved air and other gases plays a very serious part in the way of corrosion. Consequently, it is necessary to use de-aerating or degassing plant so as to protect the boiler, while the particularly serious action on the steel tube economizer is well known, this being, in fact, the chief defect in the use of steel in this connexion instead of cast-iron. In the case of standard 30 ft. × 8 ft. standard "Lancashire" boilers, for example, evaporating on the average something like 7000 lbs. of water per hour, the amount of water is comparatively trifling in comparison with the weight of metal in the boiler, but in the case of water-tube boilers evaporating 300,000 lbs. per hour the circumstances are entirely different.

When what is essentially pure distilled water falls from the clouds as rain water it absorbs from the air, oxygen to about 7 c.c. per 1000 c.c. of water, together with about 5·5 c.c. of CO_2. Further, in the neighbourhood of towns, other gases also go into solution, particularly sulphurous acid and ammonia.

Roughly speaking, the average boiler feed-water contains something like 6·0 c.c. of dissolved oxygen per 1000 c.c., although naturally a great deal depends on factors such as leakage in the condenser tubes, excessive aeration in the softening plant and in pumping and handling, and leaky joints in the pipe circuits.

It should be stated that the exact cause of corrosion in boilers is to some extent a mystery, and there are two general theories on the matter, the first being that it is due to oxidation from the air through the formation of soluble ferrous bi-carbonate, caused by CO_2, that is to say, the CO_2 dissolves iron in this condition, which is then oxidized by the air in the water to insoluble ferric carbonate, whereby a fresh amount of ferrous carbonate goes into the solution again, and so on. According to this section of the oxidation principle, therefore, CO_2 has to be present before the oxygen can act.

The other general theory is electrolysis, that is to say, acids or salts must be present which act as "carriers" for electric currents between one part of the boiler plates and another, which are at a different potential due to differences in strain of the metal caused by hammering or expansion and contraction round the rivets.

The whole matter is extremely complicated, and it is quite likely that all three actions take place at the same time. The practical point, however, is that if air is present in feed-water it causes corrosion, and this can in most cases be stopped by eliminating the air. The two general methods for this purpose consist in the first place of heating the feed-water to boiling point in a closed circuit, so as to drive out the dissolved gases and, secondly, the use of chemical means. In the latter case, for example, a deep bed of finely divided iron may be used, through which the feed-water passes in the closed circuit, and all the oxygen is immediately absorbed, forming iron oxides.

It should be noted also that the use of pure distilled water for boiler feeding is now on the increase, especially in the United States, and there is much to be said for this apparently expensive practice, every precaution, of course, being taken that the water does not re-absorb oxygen.

As regards boiler feed pumps, there are two general and efficient types available to-day, that is the familiar vertical direct-acting pump and the high-speed centrifugal unit which may be driven either by a steam turbine or electric motor. For the ordinary steam user the direct-acting pump is now almost standard practice, and there are quite a large number of high-class makes on the market. It cannot be too strongly emphasized in the the first place that it is by far the best policy to buy a good-class feed pump, as the difference in price compared with the shoddy and decidedly medium-class article is very small indeed; in fact, the average good-class feed pump is one of the cheapest parts of the whole of the boiler house equipment, especially when is borne in mind the nature of the continuous service that is rendered.

THE STEAM ACCUMULATOR.

The ideal conditions for economic steam generating are to operate the boilers at constant load and with an output corresponding to the most efficient rating of the particular boiler. These conditions rarely obtain in practice, and for this reason the steam accumulated is receiving the close attention of steam engineers. As the principle of operation is not generally understood, we propose here to give a brief outline of the process as embodied in the Ruths accumulator.

The accumulator shell is filled with specially designed vertical steam nozzles which are well immersed in the water. The latter fills the accumulator to about 90 per cent. of its capacity. These nozzles, plus the water capacity, are the two essential features. The nozzles are arranged in such a manner as to give quick and intimate mixing of the incoming steam with the water in the accumulator. The steam to be stored enters through the nest of nozzles and then bubbling through the water is condensed, with a resulting increase of temperature in the water and increase of pressure in the accumulator.

This means that the total heat of the steam above that of the water is transferred to the water. In accordance with a well-established law this steam thus absorbed by the water in the accumulator is again liberated as steam immediately any drop in pressure occurs in the accumulator, that is to say, when the outlet valve is opened. This action is the essence of the working of a steam accumulator when water is used as the heat storage medium.

The next point is the capacity of the accumulator, which is dependent upon the steam pressure as well as the weight of steam required to be stored. It is important to note this point because the capacity of water to store steam heat is much greater at low pressures than when high pressure steam is supplied. The following figures extracted from a standard curve showing the heat capacity of water will make this point clear:—

Pressure of steam at beginning of discharge, lbs. per sq. in. (approx.).		Pounds of steam delivered per cub. ft. of water in accumulator, per 14 lb. drop in pressure.
25	....	1·65
50	....	1·05
100	....	0·7
150	....	0·45
200	....	0·39
250	....	0·32
300	....	0·3

These figures show that a much greater weight of low pressure steam can be stored in a given volume of water, with a corresponding reduction in size of the accumulator and also one of cheaper construction due to the fact that it has to withstand only a small steam pressure.

Modern Steam Generation.

The actual capacity of the accumulator is dependent upon the maximum and minimum working pressures, and the following approximate figures will give some idea of the capacity of the accumulator necessary for a given steam output:—

Maximum steam pressure lbs. per sq. in.	Minimum steam pressure lbs. per sq. in.	Pounds of steam absorbed per cub. ft. of water in accumulator.
70	10	4·6
90	30	3·5
110	50	2·9
130	70	2·5
190	130	1·8

These figures also indicate the lower heat capacity of the water at high pressures. A further example may be given to make this point clear. The steam absorbed by 1 cub. ft. of water with a steam pressure drop from 60 to 40 lb. per sq. in. is 1·30 lb., but only the same weight of steam is absorbed per cubic foot of water with a steam pressure drop from 220 to 170 lb. per sq. in.

These figures give some idea of the storage capacity of a modern steam accumulator. It should be clearly understood that the principal function of the accumulator is to enable the main boiler plant to work at a constant load. This means that the boilers work continuously at the mean load of the works or factory, and when the steam demand falls below the mean load line the surplus steam is automatically delivered to the steam accumulator, and when the demand rises above the mean load line the steam accumulator automatically supplies this peak load demand.

It follows therefore that the total steam storage capacity of the accumulator is concerned only with the variable load line above and below the mean load line. Taking a simple hypothetical case for the purpose of illustrating the principle involved, we will assume that a factory working ten hours per day requires 50,000 lb. of steam per hour for the first five hours, and 100,000 lb. of steam for the second five hours. The mean steam load line would therefore be represented by 75,000 lb. of steam per hour with a demand for an additional 25,000 lb. per hour during the afternoon load. Under these circumstances the boilers would work at a constant output of 75,000 lb. per hour throughout the whole ten hours, but during the morning five hours 25,000 lb. per hour would be absorbed by the accumulator, and during the afternoon five hours the extra 25,000 lb. required in the factory would be given out by the accumulator, thus supplying the 100,000 lb. per hour required for the second five hours.

Such an example as this does not occur in practice, but it has been given solely to make the principle of operating clear. It will be seen that under such circumstances 25 per cent. of boiler capacity is saved in addition to securing ideal conditions of regular load in the boiler house.

(*To be Continued.*)

At the Brussels Fair, being held 7th and 21st of April, an interesting display relating to "Carboraffin," the powerful decolorizing carbon, much used in the beet sugar industry, has been arranged, There are schemes showing the application of this preparation, a model plant, demonstrations of the decolorization of molasses, and samples of various sugars illustrating its great value in refining.

Refined granulated is being made at Central Hershey, Cuba, by passing the syrup from the evaporators through paper pulp in Vallez filters and then over bonechar in an installation consisting of thirty 10 ft. cisterns, eleven 80-pipe kilns, a decarbonizer, and 12 driers (Kent design), the liquor thus obtained being sent to the pans. Raws of good quality are boiled from the molasses from the white massecuite, and re-melted during the inter-season, when raws from other centrals are also refined for the Hershey Corporation.

Possible Improvements in the Milling of Cane.

By HUBERT EDSON.

INTRODUCTION.

Judging by the great number of articles appearing in our technical sugar journals on methods or apparatus to improve or increase the yield of sugar from the juice after it has been extracted, one might be led to the belief that there were nothing but chemical problems left to be solved in sugar manufacture. Undoubtedly, this evident interest in matters of a chemical nature is a healthy one and will sooner or later result in decidedly better processes. But, because the chemists have stirred up an interest in their work and have entered into what appears to be a publicity campaign, we should not fall into the error that there are no matters other than of a chemical nature of pressing importance. Perhaps, even a little of the publicity that is attending chemical matters could be utilized to advantage in the engineers' field. If attention is called to some of the mechanical deficiencies in our sugar factories perhaps some one will suggest the remedies. At any rate, this article is intended to present a few of the unsolved problems in the mill room and is offered in the hope that some engineer or mill manufacturer will come forward with the solutions.

The Cuba Sugar Club prints every two weeks the manufacturing reports of factories that produce more than half the sugar in Cuba and these reports are certainly representative of Cuban practice. Even a casual inspection of these data clearly indicates that there is as much need for improvement in mill work as there is in recovery of sugar from the juice after it has been extracted. By this is not meant simply the matter of getting higher extractions, but the efficiency of the existing milling plants in getting the extractions reported.

INFERIOR MILL WORK IN CUBA, ETC.

NÖEL DEERR bases all his extraction formulas on a percentage of fibre in the bagasse equal to 50 per cent. of its weight. This he calls superior mill work, but still attainable with ordinarily good operative care. Two factories in the West Indies have for more than one crop reached or passed this figure, and in Hawaii the average mill work has for years surpassed it. The two factories in the West Indies which have reached this figure in past crops are the Tanamo in Cuba and the Barahona in Santo Domingo.

In looking over the latest available Cuba Sugar Club's report at the time of writing this, only two factories are found which secure a percentage of fibre in bagasse as high as 48 per cent. and more than one goes down below 42 per cent. Only in three cases is the moisture in bagasse less than the fibre content. The money value of the difference between the mill work reported by the Sugar Club and that given by DEERR as of reasonable expectation is so apparent that it is unnecessary to calculate it. It is sufficient to say that for the present season to date it runs into hundreds of thousands of dollars to the members of the Sugar Club. This money loss is not only in faulty sucrose recovery but in the inferior heat value of the bagasse for steam making purposes.

What is the underlying cause of this inferior bagasse from the Cuban mills? Probably the universal answer from mill makers and mill engineers will be that it is due to the heavy grindings practised in Cuba. Incidentally, this is probably true, but the necessity for correcting it is all the greater because these heavy grindings have come to stay, since they are economically sound. Mills should grind more cane per day even than they are now doing, and every intelligent engineer must expect to see them do it, and also yield a better quality of bagasse than they are producing to-day.

Possible Improvements in the Milling of Cane.

VARIABLE SPEED MOTORS.

If we search deeply enough for the reason of the poor bagasse now made in the Cuban factories, we shall probably find that it is at the bottom largely a psychological one which could be removed if milling machinery took it into account. This reason is not nearly so existent in Hawaii because with their lighter grindings the danger from it is not nearly so great. Every sugar factory operator knows the disarrangement caused to orderly procedure by mill chokes. Every engineer also knows that in dealing with existing mill machinery he is dealing with an inflexible unity. The relative speed of one mill to the other is fixed in steam engine-driven mills by the mill manufacturer in his shop when more than one mill is driven from one engine. In electrical-driven mills, for which alternating current has been used up to the present time, there is somewhat more flexibility but only in the direction of slower speeds. An engineer, faced with the necessity of quantity grinding, and knowing that such a thing as absolutely uniform feed of cane to his mills is not attained, and knowing further that an excess rate of feed will cause a choke, operates his mill to take care of this temporary excess supply of cane which he knows is coming and is therefore running practically all the time with a mill that has more or less slackness in it. The result is low fibre and high moisture in the bagasse.

The means to overcome this condition seem simple and ought to be well within economical limits to attain. If each individual mill were driven by a variable speed motor it would be perfectly feasible for an attentive operator to temporarily vary the speed of any mill or mills, so as to overcome the threatened choke and return them to normal speed as soon as this danger was passed. Steam engines are hardly suited to this style of drive because of the space they would take up and the long intermediate carriers they would introduce. The usual style of governor on them, too, is hardly quick enough in action to be used. A.C. motors are also unsuited because their speed variation is only in a downward direction and secured by an absolute waste of power in grid resistence. The D.C. electrical motor seems, however, in every way suited to meet these conditions. It has a wide speed variation with no power loss, is under easy rheostat control, and controls can all be centralized in one operating point. It would seem that the only problems to be worked out in connexion with its use are in designing a power plant which would not run into excessive cost, and in devising satisfactory controls for the motors operating the mills. It is, of course, evident that alternating current is more satisfactory for power purposes in the sugar plant outside of the mill room than is direct current and, therefore, the power plant would have to contain both A.C. and D.C. generators. Other industries have met similar conditions in an economical manner and it seems reasonable to expect that it can be done in sugar mill work. If such equipment were devised and the fear of mill chokes removed, it would seem reasonable to expect an average increase of from 3 to 4 per cent. in the fibre in bagasse and a corresponding lowering in its moisture content while at the same time the grinding rate of the factories would be maintained or even increased. If such a result could be secured it would mean a great deal more in money value than has been secured from additional sugar yields due to all the improved defecation processes put into use in the past generation.

SELF-OILED GENERATOR GEARS.

One thing in a mill room that is certainly out of date in modern industrial practice is the gearing used to deliver power from the prime movers to the mills. In most cases the spurs of this gearing are only machine-moulded with later practice going to ordinary cut gear, and, generally, consideration of proper engineering practice is disregarded in the pitch of tooth used. This gearing is exposed to the air and because it must be oiled it easily attracts and holds dust particles and consequently continually wears and loses in efficiency. Probably there are few plants among those reporting to the Sugar Club where the gear efficiency is as high as 75 per cent. In other words 25 per cent. of the power generated by the engine or motor is used in running gears and not in grinding cane. Bed-plates for this gearing must necessarily be extended over a considerable area and have to be supported by expensive concrete foundations on this whole area. Each shaft is carried on adjustable pillow blocks because the gear is not made true enough to avoid field adjustment in erection. These adjustable blocks introduce additional chances for improper tooth meshing and a certain amount of danger from adjustment bolts becoming loose. It seems surprising that the mill manufacturers hold to this obsolete gearing when they have available for use modern enclosed self-oiled generator gears correct in principle and design and occupying so much less space that over 20 per cent. of the present gearing foundation cost could be avoided if they were used. Mill buildings could be made narrower and cranes shortened, while perfectly rigid pillow blocks for the gear shaft could be used, which could be set for each mill on single bed plates carrying even a triple reduction for motor drives up to 750 revs. per min. And all this can be done with a transmission efficiency of from 95 to 98 per cent. depending upon the number of reductions used, with a net resultant cost not exceeding the present type of gearing. Efficiency is maintained by this generator gear at high speeds and, therefore, higher-speed, lower-cost prime movers could be used than is possible with the present gear. It is high time that for the sake of economy and efficiency our engineers should insist on the manufacturers supplying them with the proper style of gearing.

Maceration Systems.

A third glaring deficiency in mill work, and perhaps the most important one in monetary gain if it were corrected, is the low efficiency of the methods for applying maceration. Let us take for example one of the higher extraction figures given in the Sugar Club's report previously referred to, which is 94·66. This extraction was secured with 17·29 per cent. saturation. Taking 47·42 per cent. fibre in the bagasse as reported from this mill and using Deerr's formula for calculating the extraction which should have been secured with quadruple compound maceration (and this particular mill has a sufficient number of rolls for maceration at four or more different crushings), this extraction should have been with just the same quality of bagasse 99½ per cent. or with simple maceration 96·4 per cent. Probably the system of maceration was a mixture of both the simple and compound systems and therefore under their method of operation the extraction that should have been secured would run somewhere between the two or say about 98 per cent. In this particular factory 2·17 lbs. of 96° test sugar per ton of cane was secured for each 1 per cent. extraction, and if maceration had been fully efficient 3·34 per cent. higher extraction would have been secured, and consequently 7¼ lbs. more of sugar per ton of cane put in the bag. With sugar worth only 2 cents per lb. this would mean 14½ cents on each ton of cane ground. As this factory was grinding considerably more than 3000 tons of cane per day, this lack of maceration efficiency is costing it about $500 in each 24 hours. Bear in mind that the example taken is one of the higher extractions reported by the Sugar Club, and there are many down to 90 and 91 per cent., with maceration efficiency poorer; so that the loss from this cause in them can easily be twice the above figures.

On this matter of maceration efficiency it would be well for every engineer and every factory owner to study the tables of computed extractions for various macerating conditions given in DEERR's "Cane Sugar," page 237. It is immediately apparent from these that, with a mill containing twelve or more rolls, maceration should always be by the compound system. With the same recovery efficiency, the extraction obtained by the compound system cannot be equalled by the simple system and, therefore, the nearer approach to the compound system, the higher will be the extraction. This is a matter that the operating engineers should attend to, and the Sugar Club figures show there is not a single factory reporting to it that does pay proper attention to this matter. A method to overcome the inefficiency in maceration applications can well be studied by mill manufacturers as well as by the operating engineers. What is necessary is to secure an intimate and proportionate admixture of the macerating liquid with the bagasse and not simply to saturate the top layer of the mat of bagasse as present methods of application do. No change in mill settings or methods of grinding are required. If a means for proper admixture of macerating liquid is devised, then a mill, operated, as the better class of mills reported by the Sugar Club, will get a 98 per cent. sucrose extraction with an 18-roller mill and 10 per cent. maceration, or the same extraction with a 15-roller mill and 15 per cent. maceration. Should as high extractions as this be not considered economical, then a less number of mills in the tandem will be required.

MILL JUICE STRAINING.

Another mill adjunct that needs material improvement is the juice strainer. This has been recognized for some time, and several creditable attempts have been made for improvement, but the satisfactory solution has not yet been reached. Chemists tells us that sugar recoveries would be improved and incrustations on heating vessels lessened if the fine *bagacillo* carried on with the juice was entirely removed. It is difficult to calculate just what would be the money value of this elimination, and for that reason owners naturally hesitate about introducing an additional piece of apparatus over the one now in use. If, however, an apparatus could be devised that would be set in more or less the same position as the present juice strainer, be easily cleanable, remove the *bagacillo* now going into the juice, and be supplied at practically the same cost as are present juice strainers, it would, undoubtedly, have a ready sale. This is especially evident when we consider that the present strainers as constructed are not long-lived and have high upkeep costs.

CANE SHREDDING.

Still another mill room problem, the importance of which for heavy Cuban grindings is a disputed point among engineers, is the shredding of the cane. With the high power consumption of such machines as the Searby Shredder,[1] which power most engineers seem to believe can be more economically used in crushing machinery, and with the difficulties in operating, which are apt to follow the use of a high-speed machine at this point, such apparatus has not come into favour in the West Indies. If, however, a shredder using materially less power than the ones now in use was brought out and a means for proper admixture of macerating liquids with the bagasse was devised, the shredder would come into more general demand, since it, undoubtedly, would put the bagasse in the proper degree of fineness for maceration applications with a less number of crushings than is done at present. This would result in higher extractions with the same number of rolls in the tandem, or in the same extraction with a less number of rolls.

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[1] As to this see, however, *I.S.J.*, 1926, 105.—ED.

It can be seen that two of the fields for suggested improvement in the mill room more or less overlap and to solve one will lessen somewhat the value of the other. If the variable speed drive for the mill is installed it would produce higher extractions which would of themselves increase the efficiency of the maceration applications, but would not do this to a degree that would remove the urgency for a better mixture of the maceration liquid with the bagasse.

Cuba's Capacity for Sugar Production.

(From a Correspondent.)

Cuba has long been called the sugar-bowl of the world, and certainly her abundant production of that article has entitled her to such a designation. Going back to the year 1853 we find that the output of sugar in those days was a little over 300,000 tons; thereafter the increase in production was somewhat irregular but by 1894 the output had reached the million-ton mark.

Then the war of independence from Spain intervened, and caused an immediate and big drop in Cuba's production, and during 1896 and 1897 the output was no more than 225,000 tons and 212,000 tons respectively. But from that time onwards the production gradually increased again, though with some fluctuations, and in 1904 Cuba again attained to the million ton output. It may be said to have been from this date that the active and regular increase in sugar production has taken place in Cuba. Foreign capital, mostly American, began to take an interest in the island, public railroads were constructed, and the development of sugar lands took on a new and rapid lease of life.

The construction of the railroads naturally led to the opening up of new territories, providing routes to what had hitherto been inaccessible cane lands. Sugar interests began to acquire large areas of forest lands (which in Cuba are the best for cane cultivation) in these newly opened territories, and started to clear them of their timber and plant the clearings with sugar cane. Sugar factories were erected in central locations, and vast networks of private railroads were laid out to transport the cane from the surrounding districts to these factories, as well as to convey the finished sugar and molasses to the public railroads for consignment to the ports. This process of development has continued almost uninterruptedly, with the result that to-day about five million tons of raw sugar are being produced annually.

Some sixteen years ago or even less, when travelling through the eastern provinces of the country by rail, the train passed for hour after hour through virgin forest lands, and not a canefield was to be seen. Those forests showed the observer that great areas of land remained to be exploited by agricultural interests, and awaited only the coming of the axeman and the cane planter to make their transformation complete. To-day, on taking the same journey, one sees everywhere great fields of cane where the forest once used to be, and it is vividly impressed on one that the available sources for new cane lands are fast disappearing.

The question consequently crops up as to what further development is likely to take place in Cuba's sugar industry. Will the yearly output extend much further beyond the present five million-ton mark, or will it remain stationary at about that figure, or will it on the contrary diminish in the not distant future? To answer these questions rightly, two other questions must first be faced which are: (1) Has Cuba any large areas of undeveloped lands still available, suitable for the economic cultivation of sugar cane, and such as will allow her to continue her present-day methods of extensive as opposed to intensive cultivation ; and (2) will the Cuban farmer take at all readily to intensive methods of cultivation once his rich new or virgin lands have been so cropped that they no longer produce the heavy yields to which he has been accustomed and require instead skilled methods to produce cane in sufficiently heavy tonnage to give economical results ? On these two factors hangs the answer to the larger question.

To deal with the first point—the extent of Cuba's reserve lands—it may be said here that there are still a few but very few large tracts of land left which are still available for development as sugar properties ; but these have for the time being no suitable transport facilities and it may therefore be some years yet ere they can be properly opened up. Many of the producing properties have still land in reserve, which is being held for the day when the fields at present in cultivation show signs of exhaustion ; but in the aggregate those lands do not amount to any vast acreage. It is therefore undoubtedly the case that Cuba is very close to the end of her customary habit of extensive cultivation of sugar cane, and will be under necessity of applying the most modern and scientific agricultural methods if her present output is to be maintained, let alone increased.

With the greater part of all the suitable and available cane lands under modern cultivation Cuba could certainly produce more than her present output, and given such favourable conditions her production may in the near future attain to as much as six million tons.

But will the Cuban farmer take readily to scientific methods of cane cultivation ? This is a much debated question, and a matter of varying opinion. But it is safe to say here that the Cuban farmer if left alone would be loth to drop his old and primitive methods that have been handed down to him for generations, even though his present-day crops are light and do not represent anything like the productivity that his lands would show under intensive cultivation. To induce him to grow heavier crops by modern methods, he must be taught the advantages that would accrue to him thereby and must be helped to carry out the transformation. The sugar mill owners must educate him to the new standard required in cultivation, showing him how to raise heavier and more economical crops. In fact the day is fast approaching when they will all be forced by circumstances to undertake this task. A few are doing it already, but the vast majority have still to make a start in educating their farmers. Without going into details here as to what precise methods will be followed, it may be assumed to be indispensable that the older lands should have their lost productivity restored if they are to continue to yield a sufficient tonnage of cane to keep the factories fully supplied.

If these two conditions are satisfactorily solved, Cuba's future outlook for sugar production should be a satisfactory one. But the present position is that she is getting close to her maximum productive capacity under existing conditions, and when that point is reached it may be followed by a decided drop in the output for a few years, since it will require several years for her agriculturists to adapt their methods to modern requirements. But the safety of her principal industry and the livelihood of the bulk of her agricultural population are matters of too great moment for Cuba, to be left long neglected and unsolved.

Dr. W. E. Cross points out[1] that varieties such as D 1136, POJ 228, Purple and Striped Criolla, and particularly the POJ 2725 have not the same liability to deteriorate after cutting as others, for example, POJ 36 and 213, the sucrose content in which decreases comparatively rapidly.

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[1] *Revista*, 1925, 16, 46–30.

The Prevention of the Deterioration during Storage of Raw Sugars by their Inoculation with Torulæ.[1]

By WILLIAM L. OWEN,
Research Bacteriologist, Louisiana Sugar Experiment Station.

INTRODUCTION.

The writer was the first to call attention to the antagonistic activities of torulæ towards the development of mould fungi in raw sugars; and was apparently the first to show that the inoculation of raw sugars with the former group of micro-organisms would effectually suppress the latter and prevent deterioration during storage.

It was also established during the course of the investigation that the restraining action of the torulæ upon mould development is due to the carbon dioxide (CO_2) formed by the former during fermentation within the molasses films surrounding the sugar crystals.

These researches led directly to the enquiry as to the concentration of CO_2 necessary for the suppression of mould growth within the molasses films of raw sugars, and as to the species of torulæ, the activities and fermentation efficiency of which especially fit them for the benign rôle of preventing sugar deterioration in storage.

It was thought that with these data available a process might be elaborated for the protective inoculation of sugars with suitable torulæ species; and that in this way the problem of the preservation of raw sugars from spoilage might be solved.

Accordingly, in the first part of this work experiments were carried out for establishing the following: a method of determining the concentration of carbon dioxide held in molasses films; the time required for the development of adequate concentrations of carbon dioxide by torulæ; and the amount of this gas required to protect the sucrose within the films from inversion by mould fungi.

Following this a process was developed for inoculating sugars with adequate numbers of the proper species of torulæ to insure the maintenance of the required concentrations within the molasses films surrounding the sugar crystals. At first inoculated molasses was mingled with the sugars previous to centrifuging; but later it was decided that it would be preferable to spray the inoculated molasses upon the sugars while purging them in the centrifugal, an atomizer used in spraying insecticides being connected to a small Erlenmeyer flask by a rubber stopper provided with a hole for the connecting tube.

INOCULATING PROCEDURE AND THE RESULTS OBTAINED.

Definite weights of sugar were mingled with definite portions of sterilized molasses and the sugar purged in the centrifugal. After all the surplus molasses had been separated in the centrifugal, the sugar was sprayed with 5 per cent. by weight of inoculated filming molasses, in one case, and sterile molasses in the case of the control samples. The samples were then bagged and incubated as before, portions of each sample being analysed promptly after their removal from the centrifugal. A third sample of Cuban 96-test sugar was used for the purpose, the analysis of which is given in Table 14 with that of the sugars made at various intervals during the cycle of operations. These analyses show that except in the first week the inoculated film sugars were higher in polarization than the controls, although never as high as the original sugar, which was very dry and of a high polarisation. The analyses of the molasses from the yeast apparatus, at the different intervals at which it was used, are given in Table 15.

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[1] Extracted from "The Deterioration of Raw Sugar in Storage," a 50-page reprint of articles published in *Facts about Sugar*. For previous work by Dr. OWEN on this subject, consult *I.S.J.*, 1923, 371.

In this run of the apparatus, the development of the torulæ was not quite satisfactory, being 1,750,000 the first week, 3,990,000 the second, and 1,920,000 the third. The CO_2 content of the filming molasses was 0·054 and 0·052 for the second and third weeks, respectively. The drop in reducing sugar was from 12·5 to 9·0, and the increase in polarization was from 44·8 to 47·2. The analysis of the sugars at the end of the incubation period was as shown in Table 16.

TABLE 14.

Summarized Data on Third Run of Torulæ Propagating Apparatus, showing Increase in Purity of Inoculated Molasses and Rate of Torulæ Development.

Sample	Corrected Brix.	Pol'n.	Sucrose (Clerget).	Red'g Sugars.	True purity.	CO_2	Torulæ per gram.
First Week—							
Control	69·82	44·8	49·18	12·5	71·0	—	0
Inoculated	69·82	46·0	49·42	11·3	70·7	—	1,176,000
Second Week—							
Inoculated	66·07	46·0	49·38	11·3	74·6	0·054	3,990,000
Third Week—							
Inoculated	63·70	47·2	48·82	9·0	76·6	0·054	1,920,000

TABLE 15.

Summarized Data on Filmed Sugar No. 3, showing Increases in Initial Polarization. 5 per cent. Inoculated Molasses Sprayed on Sugar while in Centrifugal.

Sample.	Moisture pct	Pol'n.	Sucrose (Clerget).	S C. (dry basis).	Factor.	Red'g Sugars.	Torulæ per grm.
First Week—							
Cuban No. 3	0·65	97·6	97·85	98·5	0·302	1·5	—
Control	2·70	92·2	93·13	95·7	0·393	2·0	600
Inoculated	2·55	94·6	94·37	96·8	0·452	1·7	1,800
Second Week—							
Control	2·60	93·8	94·22	96·72	0·449	1·66	0
Inoculated	2·00	95·7	96·36	98·32	0·540	1·25	33,400
Third Week—							
Control	1·15	95·3	06·15	97·26	0·299	1·66	—
Inoculated	1·85	95·0	95·75	97·45	0·435	1·60	20,000

The samples from the first week had all increased in polarization as a result of a loss of moisture, except the original sample, which had a very low moisture content at the beginning of the experiment and had absorbed nearly 1·5 per cent. during the storage period with a resulting loss in polarization. The torulæ content of the filmed sugar was apparently insufficient to have much effect upon the reducing sugar content.

The results of the first week's series, where the inocculated film sugars contained 33,400 torulæ per grm., are most striking. Here the protectively filmed sugars were 3·5 to 4 per cent. higher in polarization than the controls. While the control samples had undergone no deterioration in storage, as measured by their true sucrose on a dry basis, yet they were much more hygroscopic, as is shown by their comparatively high moisture content. The inoculated film sugars had not only lost most of their moisture but most of their reducing sugar as well, which made their true sucrose as well as their polarizations much higher than in the beginning of the experiment.

The results of the third week's run of the apparatus were even more conclusive than those of the one preceding. Here the controls had absorbed a great deal of moisture and had undergone some deterioration as measured by the sucrose (Clerget), dry basis. The protectively filmed sugars had not only increased in polarization as a result of their loss of moisture, but they had also increased by one degree in true sucrose calculated on the dry basis as a result of the elimination of their reducing sugar by fermentation.

TABLE 16.

Comparative Deterioration of Inoculated and Control Films, Cuban 96° Sugar No. 3, during One Month's Storage.

Sample.	Moisture pct.	Pol'n.	Sucrose (Clerget).	S.C. dry basis.	Orig. S.C. dry basis.	Red'g Sugars.	Moisture change.
First Week's Run—							
Control (1)	2·25	95·4	94·92	97·10	95·7	1·70	—0·5
Control (2)	1·85	95·6	95·90	97·70	95·7	1·60	+0·1
Inoculated (1)	1·50	95·6	95·23	96·60	96·8	1·19	—1·0
Inoculated (2)	2·25	95·0	95·11	97·29	96·8	—	—0·3
Second Week's Run—							
Control (1)	1·30	94·1	95·22	96·47	96·72	1·91	—1.3
Control (2)	1·65	95·1	95·90	97·40	96·72	1·47	—1·0
Inoculated (1)	0·50	98·1	98·42	98·91	98·32	trace	—1·5
Inoculated (2)	0·035	98·6	99·19	99·50	98·32	0	—1·7
Third Week's Run—							
Control	3·15	93·6	94·10	97·16	97·26	1·61	+2·0
Inoculated (1)	1·95	96·2	96·12	98·00	97·45	trace	+0·1
Inoculated (2)	1·85	96·8	96·58	98·40	97·45	trace	0

TABLE 17.

Comparative Value of Increased Polarizations resulting from Protective Inoculation Experiments, calculated upon enhanced Values per Ton of Raw Sugars. Values computed on Basis of 4 cents. per lb. for Raws.

Sample.	Initial increase over control deg. pol.	Value of inc. per ton raw sugar. $	Final increase over control deg. pol.	Value per ton. $	Final increase over original deg. pol.	Value per ton. $	Net increase over control per ton. $
I (1)	0·60	1·08	1·50	2·79	0	—	2·10
I (2)	0·50	0·90	2·00	3·60	0·30	0·54	2·80
I (3)	1·10	1·98	2·70	4·86	0·60	1·08	3·34
I (4)	0·60	1·08	3·30	5·94	1·60	1·44	5·50
II (1)	0·95	1·71	1·40	1·12	1·50	2·70	0·82
II (2)	0·80	1·42	1·85	3·30	1·20	2·16	2·62
			0·70	0·56			
II (3)	0·90	1·62	2·40	4·32	2·30	4·14	3·04
			1·60	3·20	2·00	3·60	
III (1)	2·40	4·32					
III (2)	1·90	3·42	4·00	7·20	0·50	0·40	5·60
			3·50	6·30	1·00	0·80	5·18
III (3)	0·70	1·26	2·60	4·68		1·45	
			3·20	5·76			

ADVANTAGES OF INOCULATION.

From these experiments it is clear that the protective inoculation of sugars accomplishes the following very desirable objects: It contributes a higher initial polarization to the sugar at practically no expense, and thereby enables a sugar to carry a larger percentage of molasses and still maintain the desired polarization.

It gives a better keeping sugar because it reduces the hygroscopic quality of the films, as well as making them less suitable for the development of moulds. It makes a lighter coloured sugar.

It enables sugars to carry molasses films of higher purity, and consequently higher moisture non-sucrose ratios, and still be safer from deterioration than where the sugars conform to the non-sucrose moisture ratio of three to one, as required by the factor of safety. It reduces the viscosity of the molasses films of sugars and improves their purging qualities, making them easier to wash and refine.

Taking the customary scale of allowances for raw sugars polarizing above and below 96° and applying them to the samples given in the preceding tables, we have calculated gains per ton of raws as shown in Table 17.

It will be noted from the table that the average initial gain in polarization of the inoculated samples over the control amounted to $1·87 per ton of sugar, and the final increase to $3·56 per ton. The value of the average final increase over the original is $1·45 per ton, or as calculated on the samples that showed increase instead of upon the total, the gain is $2 per ton. Now what do these figures mean as expressed on the average annual output of raw sugar factories? Take for the purpose of illustration an average capacity of 100,000 bags; the increase in initial polarization resulting from inoculation would amount to an enhanced selling value of $26,000, and the final increase would be over $50,000.

A FURTHER PRACTICAL TEST.

In order to obtain data under conditions more nearly parallel to those under which raw sugars are produced, the following experiment was carried out. A sample of Cuban first molasses was divided into two portions, both of which were sterilized in Erlenmeyer flasks; after cooling, the contents of one flask were inoculated with torulæ and the other was kept for control. At the end of two weeks the analyses of the samples were as shown in Table 18.

TABLE 18.

Increases in Purity and Polarization of Cuban First Molasses resulting from Inoculation with Torulæ.

	Molasses Original.	After two weeks' inoculation.
Approximate purity	69·00	76·00
Corrected Brix	71·30	68·39
Single pol'n	49·60	52·00
Sucrose (Clerget)	54·65	49·96
Reducing sugars	11·49	6·50
Torulæ per grm.	—	2,080,000

The polarization of the inoculated molasses had increased from 49 to 52, its reducing sugar had decreased correspondingly, and its torulæ content was 2,080,000 per grm. The two portions of molasses were now used to film a Cuban 96-test sugar, the same proportion between weights of molasses and sugar being maintained in both cases. The analyses of the sugars obtained were as shown in Table 19.

The use of the inoculated molasses, it will be observed, resulted in an increase of 1·4° in the polarization of the sugars made with it, as compared with the control. The sugars were placed in bags and incubated as in the previous experiments. The results of one month's storage are shown in Table 20.

It will be seen from this table that the protective filming of the sugars resulted in final increases in polarization over the control of 3·4 and 3·2, respectively. The value of these initial and final increases amount to an average of $2·50 and $5·94 respectively per ton of raw sugar. Referring to Table 17, under the last column to the right we find the net gain from increased polarization. These figures are derived from the increased polarization values, less the loss in weight resulting

TABLE 19.

Increase in Initial Polarization from Filming Cuban 96° Test Sugar with Inoculated Molasses.

	Control.	Inoc. Film.
Moisture, per cent.	2·85	2·45
Single pol'n.	93·20	94·60
Sucrose (Clerget)	94·17	94·23
S.C. (dry basis)	96·93	96·70
Reducing sugars	1·88	1·70
Torulæ per grm.	—	13,300

from the fermentation of reducing sugars and loss in moisture. Since the loss in reducing sugar is accompanied by a loss in weight due to the escape of CO_2, we have assumed a shrinkage in weight equivalent to 51 per cent. of the reducing sugars destroyed during fermentation. The actual loss is less than this, since we have observed that from 0·03 to 0·06 per cent. of CO_2 by weight is entrained in the molasses film.

A comparison between the factors of safety of the controls and the inoculated samples shows that the average factor of the control samples is 0·418, as compared with 0·498 for the inoculated, but in spite of the higher factor only 8 per cent. of the latter samples lost either in polarization or in actual sucrose as calculated on the dry basis. Two-thirds of the control samples deteriorated, and one-third lost in polarization. The average deterioration of the controls was 0·5 per cent. per sample, or 0·9 per cent. per sample deteriorating, or 1·6 per cent. of the samples losing in polarization. Of the inoculated samples only one showed any loss of sucrose calculated on the dry basis, and this was so small as to be well within the limit of experimental error. This shows that the protectively inoculated sugars were safer than the controls, even with a non-sucrose moisture ratio of approximately two to one instead of the precribed three to one of the factor of safety. Even the original samples, with an average factor of 0·262, were not immune from deterioration, one of them losing 1·7 in polarization and 1·1 in true sucrose during the storage period. It is thus apparent that protective inoculation is superior to conformation to the factor of safety as a means of protecting sugars from deterioration.

TABLE 20.

Comparative Deterioration of Control and Inoculated Film Sugars after One Month's Storage.

Sample.	Moisture pct.	Pol'n.	Sucrose (Clerget).	S.C. dry basis.	Orig. S.C dry basis.	Red'g Sugar.
Control	1·65	92·2	93 38	94 94	96·93	2·20
,,	1·95	93·0	93·49	95·34	96·93	1·90
Inoculated	2·00	95·6	95·06	97·00	96·70	1·56
,,	2·00	96·2	95·67	97·50	96·70	1·56

SUMMARY.

(1) The deterioration of raw sugars can be prevented by their protective inoculation with torulæ.

(2) Sugars filmed with inoculated molasses are safer with a non-sucrose moisture ratio of two to one than are uninoculated sugars with a ratio of three to one, as prescribed by the factor of safety.

(3) The net gain in value from the increase in polarization in the samples protectively inoculated in these experiments averaged $3·50 per ton of raw sugar, while the initial gain in polarization from filming sugars with the inoculated molasses was equivalent to $3·56 per ton.

(4) The concentration of CO_2 required for the prevention of mould growth in syrups and molasses appears to be approximately 0·036 per cent. by weight, and this concentration is usually reached during the first or second week after their inoculation with torulæ.

(5) Sugars protected from deterioration by inoculation with torulæ are not only safer than uninoculated sugars during storage, but are much less hygroscopic, and also lighter in colour.

Decolorizing Carbons: their Comparative Value and their Suitability for Sugar Refining.[1]

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COMPARISON OF PROPERTIES OF CARBONS AND BONECHAR.

Of primary importance, of course, is the decolorizing power of the carbon: the greater its capacity for adsorbing colour, the smaller the amount of carbon which must be used for the decolorization of a given quantity of sugar liquor. The decolorizing efficiency should be high in neutral or alkaline liquors, in order to avoid inversion losses that would occur if it were necessary to maintain the liquors in an acid condition. Second in importance to the decolorizing properties of the carbon are its filtering qualities. In order to permit of handling the treated liquors with a reasonable filter-press installation, an ideal carbon should be highly efficient as a filter aid. The filtration of carbon-liquor mixtures by addition of kieselguhr or other filter aid is not a desirable expedient, as the addition of foreign matter complicates the regeneration of the carbon.

The ideal carbon should have a high capacity for adsorbing non-sugars. Each lb. of ash eliminated from sugar liquors means an increase of approximately 2·5 lbs. of sugar recovered through crystallization. Moreover, the ideal carbon should be low in first cost, and should be economical to regenerate.

Carbons were examined from all angles that might have a bearing on their value (each being designated by a letter). Carbon *A*, a widely advertised commercial carbon of European manufacture. Carbons *B*, *C*, and *D*, well known commercial carbons manufactured in the United States. Carbon *E*, a carbon developed in the Hawaiian Islands, and not yet manufactured on a commercial scale. New bonechar, 8/24 mesh, of the quality ordinarily used in this refinery, was used for comparison with the above carbons, and with (*a*) powdered new bone char and (*b*) char carbon, i.e., the residue after repeated extractions of bone char with concentrated hydrochloric acid.

Prior to testing, all the carbons and the bonechar were very thoroughly washed first with pure hot tap water and finally with hot distilled water, then dried at 110° C. Those carbons which still showed an acid reaction after washing were treated with dilute ammonia until approximately neutral, re-washed, and re-dried.

It was later found necessary, in order to obtain satisfactory ash removal tests, to digest samples of carbons *A*, *C*, *D*, and *E*, with 1 per cent. hydrochloric acid in order to remove mineral matter soluble in the slightly acid crystallizer remelt sugar liquor. After digestion, these carbons were thoroughly washed, neutralized, and dried.

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[1] Extracted from a paper entitled "Decolorizing Carbons," published in *Industrial and Engineering Chemistry*, 1926, 18, No, 1, 32-42. The first part of this paper, dealing with analytical methods is abstracted elsewhere.

Chemical and Physical Properties.

Analyses of the carbons tested were found to be:—

	Carbon Per cent.	Insoluble ash Per cent.	HCl-soluble ash Per cent.
Char carbon	98.69	1.31	Trace
Carbon *D*	98.55	0.78	0.67
Carbon *A*	97.09	1.81	1.10
Carbon *E*	96.34	0.77	2.89
Carbon *C*	93.60	6.00	0.40
Carbon *B*	69.32	30.31	0.37
New char	9.43	0.04	90.53

All the carbons, with one exception, are very rich in carbon and low ash. The *pH* of each carbon, after washing, was determined by boiling 20 c.c. of carbon with 40 c.c. of distilled water for 1 min., filtering, and testing the filtrate, the values so determined were:—

	pH.		*pH.*
Carbon *A*	8.25	Char carbon	6.25
New char	8.00	Carbon *E*	5.50
Carbon *C*	6.75	Carbon *B*	4.50
Carbon *D*	6.25		

It was found impossible to neutralize the acid reaction of the last five carbons by washing alone, a weak alkaline digestion, followed by a thorough washing, being necessary.

The low *pH* of carbon *B* is presumably residual acidity from treatment with an acid solvent after carbonizing, whilst *E* owes its acidity to the presence of traces of phosphoric acid used in its manufacture. New bonechar is always alkaline, owing to the high calcium carbonate content and to the presence of traces of calcium oxide produced in the kilning process. Carbon *A* contains a small percentage of slightly soluble ash, which imparts an alkaline reaction to the carbon and is best removed by digestion with 1 per cent. hydrochloric acid prior to use.

When using carbon on a large scale, in order to prevent serious inversion and at the same time obtain a high decolorizing effect, the carbon, as well as the liquor, should have a *pH* of from 6·5 to 7·5. An acid carbon, like *B*, or an alkaline carbon, like *A*, would require neutralization prior to use. These preliminary treatments would involve considerable extra handling and expense.

Following is a tabulation of the weight per cub. ft. of the carbons, loose pack and solid pack:—

	Loose pack Lbs. cub. ft.	Solid pack Lbs. cub. ft.		Loose pack Lbs. cub. ft.	Solid pack Lbs. cub. ft.
Carbon *D*	10.5	13.5	Carbon *C*	16.0	19.2
Carbon *A*	14.0	18.4	Carbon *B*	17.9	22.5
Carbon *E*	14.4	26.9	Powdered bonechar	38.3	—

The carbons with the highest ash content, i.e., powdered bonechar, *B*, and *C*, have the highest unit weight, and (as will be observed later) the lowest efficiency as filter aids.

Screen analyses of the carbons tested are tabulated below (50-grm. samples screened for 10 mins. in a Tyler "Ro-Tap" machine):—

Decolorizing Carbons: Comparative Value and Suitability for Refining.

Screen mesh.	*E.*	*A.*	*B.*	*D.*	*C.*	Powdered bonechar.
On 50....	0.8	0.2	1.6	7.1	0.4	0.0
On 70....	3.8	7.2	7.9	20.5	1.3	0.1
On 100....	5.3	11.1	13.2	11.7	8.4	1.4
On 150....	11.2	14.5	16.5	13.8	20.5	10.0
On 200....	13.7	12.7	20.3	14.2	38.9	24.3
On 250....	6.5	4.8	3.7	5.4	12.5	9.2
On 300....	6.5	8.2	6.6	8.0	7.9	22.3
On 350....	10.3	10.2	6.6	5.5	2.1	11.6
Through 350....	41.9	31.1	23.6	13.8	8.0	21.1

The wide variation in the percentage of fines contained in the different carbons should be noted.

When viewed under the microscope, carbon *A* was seen to consist of innumerable needle-like carbonized vegetable fibres. Carbon *B* and powdered bonechar had a somewhat granular structure, while *C*, *D*, and *E*, were very flocculent powders.

FILTRATION EFFICIENCY.

In order to rate the carbons under examination with regard to their efficiency as filter aids, they are compared with standard "Filter-cel" by means of the Elliott filtration test for raw sugars, using 2 per cent. of carbon on solids, the kieselguhr being arbitrarily rated as 100 per cent. efficient.

Two sets of filtration tests were run. In the first, the filter aid and liquor were allowed 5 minutes' time of contact in the cold (this being the standard method of conducting the test); and in the second, the filter aid and liquor were heated just to boiling, then cooled to room temperature, in order to allow the adsorptive properties of the carbons to assert themselves.

Following are the results of these filtration tests:-

edium.	Carbon and liquor mixed in cold 5 mins. contact, Per cent.	Carbon and liquor mixed, heated to boiling, then cooled, Per cent.
Filter-cel..........	100.0	100.0
Carbon *A*	59.7	127.5
Carbon *D*	33.0	82.2
Carbon *C*	30.0	58.8
Carbon *E*	15.4	36.0
Carbon *B*	11.6	62.5
Powdered bonechar	9.2	34.8

The results of the first set of tests, in which the time of contact of liquor and carbon was limited to five minutes in the cold, may be assumed to indicate the relative value of the carbons as filter aids due to their actual physical structure. It will be noted that under these conditions Carbon *A* is approximately 60 per cent. as efficient a filter medium as the standard "Filter-Cel" while the other carbons are relatively much lower in filtration efficiency. Structurally, therefore, none of the carbon examined compares at all favourably with "Filter Cel" as a filter aid.

In the second set of tests, in which the liquors were heated in contact with the filter medium, the time of contact was sufficient to establish adsorption equilibrium between filter aid and liquor, and a portion of the gums and colloids in solution was adsorbed. The filtration efficiency figures are, therefore, the resultant of the structural and the adsorptive properties of the filter media. Observe that Carbon *A* under these conditions appears to be a more efficient filter aid than "Filter-Cel," while Carbon *D* compares very favourably with it. In general, after heating, all the carbons tested are greatly improved in filtration efficiency as compared with "Filter-Cel," indicating that they adsorb a considerably greater quantity than does "Filter-Cel" of gums and colloids, which have a retarding influence on filtration.

The tests as a whole indicate that in all probability Carbons A and D are the only ones which would give satisfactory filtration rates without pre-filtration through some filter-aid or mixture with it.

DECOLORIZING EFFICIENCY.

On the basis of a decolorizing test developed, two sets of decolorizing isotherms were prepared for each carbon under consideration. In one set of curves the test liquor was washed raw sugar liquor of 98·8° purity, and 15° to 20° Stammer per 100° Brix, and in the other the test liquor was crystallizer remelt sugar liquor of 88·5° purity, and 52° Stammer per 100° Brix.

All the washed raw sugar liquor isotherms exhibited a characteristic form. The relatively low decolorizing power of granular bonechar, due to its limited adsorptive surface, is very striking. Powdered bonechar is much higher in decolorizing efficiency, and the carbon extracted from bonechar by acid digestion is still better. All these substances, however, are decidedly inferior to the carbons tested.

Efficiency figures were calculated from the foregoing decolorizing isotherms. The figures in (*a*) in table below were calculated on the basis of the relative weights of carbon necessary to remove 80 per cent. of the colour from washed raw sugar liquor, 47·5° Brix. Those in (*b*) were calculated on the basis of the relative weights of carbon required to remove 50 per cent. of the colour from crystallizer remelt sugar liquor, 47·5° Brix.

	(*a*) Based on washed raw sugar liquor.	(*b*) Based on crystallizer remelt sugar liquor.
Carbon *E*	86.4	33.7
Carbon *D*	54.3	14.4
Carbon *B*	43.5	15 9
Carbon *C*	34.4	14.6
Carbon *A*	32.8	16.9
Char carbon	19.3	6.9
Powdered char	12.4	4.2
Granular char	1.0	1.0

A comparison of the two sets of figures indicates that as the character and intensity of the colouring matter in the test liquor is varied the relative order of decolorizing power of the carbons changes. This is due to differences in the selective adsorptive properties of the carbons.

As carbons would presumably be used on the high purity washed raw sugar liquor, more significance should be attached to the efficiency figures calculated from the washed raw sugar liquor isotherms.

ASH ADSORPTION.

Sulphated-ash determinations on the filtrates from the crystallizer remelt sugar liquor decolorizing tests were made to determine the ash adsorption by the various carbons under consideration :—

Carbon on dry substance	GRAMS ASH REMOVED BY[1]							
Per cent.	*D.*	Powdered char.	*E.*	Unground char.	*A.*	*B.*	Char carbon.	*C*
2	0.0012	0.0030	0.0013	0.0012	0.0010	0.0009	0.0005	0.0007
4	0.0046	0.0033	0.0042	0.0033	0.0019	0.0009	—	—
6	0.0064	0.0051	0.0048	0.0036	0.0027	0.0015	—	0.0014
8	0 0089	0.0070	0.0066	0.0041	0.0034	0.0026	0.0027	0.0014
10	0.0105	0.0091	0.0074	0.0056	0.0027	0.0031	0.0032	0.0027

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[1] Ash removal from 10 grms. solution, containing 0·1940 grm. ash.

There seems to be a great lack of agreement concerning the comparative ash removal powers of decolorizing carbons and char. These tests, however, clearly indicate that all of the carbons examined exhibit ash-removal powers in some degree. Weight for weight, Carbons *A*, *B*, and *C* are inferior to bonechar, whereas *D* and *E* have decidedly higher ash-removal powers than bonechar. This is a surprising result, since the statement is generally made that decolorizing carbons do not compare with char in regard to their ash-removal powers. One possible explanation for this belief is that, prior to testing carbons, they may not always be freed from ash soluble in slightly acid test liquors, whereas in these tests the carbons were digested with dilute acid and then thoroughly washed.

It will be noted that grinding increases the ash-adsorptive power of char, a result of increasing the adsorptive surface. However, the char carbon, from which practically all of the mineral matter has been removed, is a less efficient ash adsorbent than the powdered char. This lends evidence to the theory that the mineral skeleton of the char is mainly responsible for the ash-adsorptive properties of this substance.

The ash adsorbed by decolorizing carbons, in actual practice, would be almost negligible, even in the case of those carbons which exhibit a higher ash-adsorptive power than char, weight for weight. This is due to the small percentages of carbon used and to the fact that only high-purity liquors would be treated, as will be explained in a later section.

CHANGE IN REACTION ON COLOUR REMOVAL.

Curves for each of the carbons, showing the effect of *pH* of test liquor on colour removal were constructed, all except those for Carbon *E* and char carbon, showing the same general form, a considerably greater colour removal in acid liquors than in neutral liquors, and a slightly lower colour removal on the alkaline side. Change in acidity of the test liquor apparently does not affect the decolorizing power of Carbon *E*. Colour removal efficiency of char carbon apparently is not greatly improved in acid solution, but in an alkaline solution it decreases rapidly.

Between *pH* 6·5 and *pH* 7·5, the range of alkalinity maintained in refinery liquors, any one of the carbons under consideration shows a very satisfactory colour removal. The decolorization would be increased by lowering the *pH* of liquors, it is true, but only at the expense of a certain amount of inversion.

Owing to the carbonate content of bonechar and its consequent buffer action in acid liquors, no attempt was made to prepare a *pH* colour removal curve for the sample of powdered char.

SELECTION OF MOST DESIRABLE CARBON.

If the decolorizing power alone were sufficient to determine the suitability of a carbon for use in the refining of sugars, Carbon *E* would unquestionably be chosen as the most suitable. But the following factors are also to be considered: (1) efficiency as a filter aid, (2) capacity for eliminating non-sugars, (3) unit cost, and (4) ease and economy of regeneration. Capacity for eliminating non-sugars is of relatively small importance owing to the conditions under which carbons are used—i.e., very small amounts of carbon applied to liquors.

As regards cost, there is little choice between carbons examined. Prices range from $300 to $350 a ton, approximately 3·5 to 4 times the unit cost of first grade bonechar. This high price, coupled with the large losses in regeneration, is a serious deterrent to the use of carbons on a large scale.

Limiting the factors upon which the selection is made to three—decolorizing power, filtration efficiency, and ease and economy of regeneration, it appears that Carbons *A* and *D* are the most suitable. They both have reasonably high decolorizing efficiencies, good qualities as filter aids, and presumably can be as economically regenerated as the other carbons. Of these two, Carbon *A*, in spite of its lower decolorizing efficiency, could probably be employed with the least expense because of its superior filtering qualities.

(*To be Continued.*)

The Cuban Sugar Crop, 1925-26.

(From our Havana Correspondent.)

As is well known, Cuba produced for the crop of 1924-25 the record output of 5,120,000 tons (of 2240 lbs.) of raw sugar, which was an increase of 25 per cent. over the previous year's output.

At the end of last crop, weather conditions were extremely favourable for the young and growing cane, and another record crop was confidently looked for. The favourable weather continued for a few months, the cane grew rapidly and had a most vigorous and healthy appearance and, on the then outlook, the first estimates of from 5,400,000 to 5,700,000 tons were within the scope of possibility, provided the favourable weather conditions continued. However, the usual Fall season rains failed, and a drought was experienced which made itself strongly felt. It is during the Fall season, and with an abundance of rain, that the cane grows most rapidly and shows greatest development; a lack of Fall rains has a far-reaching effect on the tonnage and richness of the cane. Very soon it became evident that the first estimates could not stand, and the hopes of the more sanguine were shattered. As a Fall drought is unusual, and a break in the weather was looked for at any moment, it was difficult at that time to make any estimate of production that would be reliable, and therefore all estimates were continually in process of changing; and it was only at about the beginning of the crop that calculations having a fair degree of accuracy were made, and even then the authorities differed considerably.

The published estimates to-day vary to some extent, and run from 4,894,000 tons to 5,373,000 tons. The lower estimate is suggested by mill owners and farmers, but, as they are desirous of stimulating the price of sugar, their figures may be taken as ultra-conservative. While the above-mentioned drought retarded to a considerable extent the growth of the cane, that effect is offset by large areas of the previous year's plantings now ready for harvesting, and also by heavy showers of rain in January and February which will benefit considerably and induce added growth to all canes due for harvesting from April onwards. Hence, the amount of cane is very large and, if nothing untoward occurs during the harvesting season, Cuba will again make a crop of around 5,000,000 tons.

This season sugar making started earlier than in previous years, and the number of factories working is slightly more than the number operating at the same date last year. The amount of sugar made to date is considered well ahead of the amount made at the same period last year. Some place the increase at 100,000 tons, but this figure may be taken as too high.

Reports from the various factories show the manufacturing yield per cent. of cane to be satisfactory, and everything bar accidents points to another big and successful crop.

Firing and Care of Locomotive Boilers.[1]

By J. A. GOOD.

The construction and upkeep of locomotive boilers have many features. One of the most essential is the correct application and care of tubes, and it is highly important that proper maintenance be given to securing the maximum results and minimum failures under operating conditions.

Tube troubles are the most general failures encountered in boilers and, where such exist, can very often be traced to mechanical causes, such as improper application or maintenance of tubes and to variation of temperature; yet many failures develop on account of inferior quality of tubes, which cannot at all times be detected on the surface or without an analysis or physical test.

The correct diagnosis of the causes is frequently the most important step in repair operations. Executives and employees who are responsible and interested in maintenance of locomotive boilers will find the study of these causes and the proper methods of making necessary repairs to be a very essential part of locomotive maintenance economy.

The firebox end is subjected to the most severe use and should be given the most careful attention so as to guard against hasty repairs which invariably give only a temporary relief and unnecessary delay and labour cost, and, sooner or later, result in taking the locomotive again out of service and doing the job right. In this regard, workmen should be instructed to take time to do work well from the first, as continual working on tubes has a very material effect in reducing not only the life of the tube ends but in some cases maltreating the tube sheet.

The use of roller or sectional expanders on the firebox end of tubes is largely a matter of local selection and the intelligence and skill of labour employed. Generally speaking, a roller expander should not be used by inexperienced men, who are very apt to over-roll excessively and reduce the tube gauge and in time injure the flue sheet. Preference in this case should be given to the ordinary type of sectional expander which is designed and most suitable to the tube size and sheet thickness. With the use of this type of expander, the chance of injury to tube or sheet is reduced to a minimum.

Leaky tubes also develop from vibration. This need not be considered of great importance as, under ordinary operating conditions, a properly set tube is well supported by the water surrounding it. The vibration encountered in the shipment of empty boilers can be the cause of loose tube ends; hence it is always advisable to lightly rework the tube ends of such boilers before placing them in service.

The abrasive action of cinders also causes "burnt off or cracked heads" and in turn develops leaky tubes. This is a condition well recognized by the railways throughout the world, using coal for fuel.

Variation in temperature is a daily occurrence with all boiler tubes. Tubes can be heated and cooled very often without becoming loose, providing all connected parts are heated and cooled uniformly, but trouble and leaky tubes are bound to develop where the variation in temperature is unequal and every effort should be exercised to guard against this condition. Definite instructions should be made to prohibit the shutting off of the oil fire and running or coasting of the engine without the burner on, as the cold air drawn through tubes will result in injuring the firebox and tubes. A coal fire partly out will also prove harmful when running. Careful firing, especially with coal, to guard against the sudden and excessive admission of cold air into the firebox will prevent leaks to a great extent and prove very beneficial to the operation of the locomotives. Where oil is used as fuel, the admission of cold air is much less due to the firedoor being closed. Firemen should at all times make it a point to close the firedoor after each shovelful of coal is applied, the result of which is bound to reflect on the life and condition of tube ends, and also the boiler.

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[1] Presented at Fourth Annual Meeting of Association of Hawaiian Sugar Technologists, Honolulu, October 26, 1925.

Unequal variation in the water temperature caused by injection of feed water is also an important cause of leaks and the correct location of boiler check is of prime importance. Boiler check should be conveniently located, but as far as possible from the firebox. When the boiler is being fed with water, the fire should be kept up. Should the throttle be closed at this time it is advisable to use the blower to assist in circulating the water in the boiler.

Many consider that the most prolific cause of leaking tubes is incrustation. This will, of course, vary with the quality of water supplied to the locomotive and the district in which the locomotive is operating. Its remedy is careful attention, and blowing off and washing out the boiler. The washing out should be done with water under a pressure of not less than 150 lbs. with the use of cleaning rods, the result of which will do much to remedy this condition and in turn allow the locomotive to steam properly and with less fuel used.

In extreme cases proper treatment of feed water to reduce its propensity for scale formation is also advisable. The proper treatment in this respect should and can be best determined by first having the water analysed to find out if water treatment is necessary. With this information, one is in a position to decide on the proper treatment.

As a general and remunerative procedure, the care of tubes and boilers by regular inspection for mechanical defects, by blowing off, by proper and effective boiler washing, and intelligent firing will prove of the greatest economy in locomotive operation and boiler efficiency. It might be well to suggest keeping an accurate record and a definite time to have the boilers washed. In any event boilers should be blown down and washed out as often as water conditions require.

While on the subject of boiler efficiency and economy, it is not amiss to call attention to the firing of an oil-burning locomotive. Oil firing differs very materially from that of coal, and more careful attention is necessary in oil-burning locomotives than in coal burning ones to render the combustion economical.

To produce the most satisfactory results, firemen should give their work close attention and both the fireman and engineer should work together. The fireman should change his fire as often as the engineer changes the throttle or reverse lever. This possibly will appear to some as being not always possible with existing labour conditions. Nevertheless, a good fireman, by following out this method of firing an oil-burning locomotive, and by being watchful and diligent, can minimize the oil consumption to a noticeable degree. In fact a fireman on an oil-burning locomotive can save or waste more fuel than he can on a coal burner.

The first essential in good oil firing is the regulation of the oil feed directly in proportion with the requirements of the work. If followed out, this will result in the consumption of a minimum quantity of oil. Increase in firing should immediately precede the opening of the throttle and a reduction should follow the closing of throttle. The engineer should give the fireman advance notice, as both enginemen should work in harmony. Forcing the fire on an oil-burning locomotive is liable to injure the firebox sheets and tubes and should therefore be avoided. In the event of an emergency making it necessary to force the fire beyond a reasonable point, care should be taken to provide sufficient water on the crown sheet to prevent damage.

The burning of oil has a tendency to deposit a gummy substance on the firebox end of the tubes. This is very likely to take place even with no appearance of smoke, soot, and even with careful firing.

The tubes of oil-burning locomotives should be cleaned of soot when running by placing a small quantity of sand in a funnel, the end of which has been inserted through the opening in the firedoor. This cleaning should be done while the locomotive is working hard. With a long stroke of valves and throttle wide open, this will allow the strong exhaust to draw the sand through the tubes, cutting the soot and gum from them in its passage and discharging it from the stack. It is better to use the sand frequently and in small quantities than to use large amounts only a few times.

To secure the maximum boiler results, clean tubes, both inside and out, are a big factor, and the boiler should be continually inspected to see that none of the tubes are stopped up. Should there be any stoppage, the use of an auger of sufficient length to reach from end to end should be followed by a careful inspection.

In view of the ease with which the extravagant use of fuel can be effected in burning oil, it appears highly advisable to exert every effort to properly handle the locomotive, the burner, and the accessories in order to obtain economical combustion and to guard against injury to boiler or firebox.

Economic Conditions of the Cuban Sugar Industry.[1]

(Department of Overseas Trade Report).

The sugar cane crops for the last few years have been increasing owing to the high prices obtained during the war and up to 1919-20. In spite of the "crash" at the end of 1920, and extremely low prices in 1921 and 1922, large plantings were made in the early part of 1922 which, during each successive year, have increased the sugar production as the cane matured, the mills all having put in better machinery to cope with the extra cane in the fields. The crop for 1922-23 was 3,603,910 tons, a drop on 1921-22 of over 444,326 tons, due partly to retrenching in 1921 and 1922 and partly to the reason that new plantings do not produce in full during the first year.

In 1923-24 the crop yielded 4,066,642 tons, while 1924-25 yielded a record crop of 5,120,421 tons owing to the increased plantings, exceptionally favourable weather and rainfall, and high sugar content of cane. Though these figures tend to point to great prosperity in the sugar industry and consequently to the quantity of money available for commerce, this did not turn out to be the case as the price of sugar in 1925 fell to 2 cents per lb.; the average price of sugar per lb. decreasing from $0·0319 in 1922-23 to $0·02425 in 1924-25.

The prosperity of the sugar industry from a financial point of view is naturally dependent on the following factors:—Tonnage of cane produced, percentage of sugar obtained from the cane, cost of production, and average market price.

The total tonnage of the last two crops has been increased to such an extent that the whole production at the end of the last crop exceeds that of 1922-23 by more than 42 per cent. This increase is really the result of plantings made in 1922-23 which matured in time for the 1924-25 crop.

The percentage of actual sugar obtained from the cane varies considerably according to provinces and localities. The following table will give a fair estimate of the lbs. of sugar to 100 lbs. of cane, according to provinces, for crops in 1922-23 and 1923-24.

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[1] Extracted from "Report on the Economic Conditions in Cuba" (November, 1925) prepared by Mr. M. H. C. Kelham, Acting British Consul-General, Havana.

PROPORTION OF LBS. OF SUGAR TO 100 LBS. OF CANE.

Province.	1922-23. Per cent.	1923-24. Per cent.
Pinar de Rio	10·87 to 13·17	7·39 to 12·36
Havana	10·12 to 13·10	9·81 to 12·48
Matanzas	9·68 to 14·47	9·48 to 12·16
Santa Clara	10·00 to 12·59	9·70 to 12·80
Camaguey	10·32 to 14·49	10·28 to 12·78
Oriente	9·64 to 13·51	9·46 to 12·79

(Figures for 1924-25 are not yet available.)

The cost of production during this last crop has been above normal owing to labour troubles both in the fields and in the transport services.

The average cost of producing sugar in Cuba is much above 2 cents a lb. f.o.b. This is the lowest price at which planters, well situated, can place a lb. of 96° centrifugal sugar on board a steamer, while to others not so well situated it costs as much as 3 cents per lb. The main items that go to cost of production of sugar are the cost of the cane, the cost of manufacture, in which are included railway freights, the empty bags and shipping expenses. The average cost of cane is between 1·50 and 1·75 cents per lb., the average cost of manufacture between 1·10 and 1·25 cents per lb., making a total cost of production of from 2·75 to 3·00 cents per lb.

Since the days of 1920, when sugar soared to 25 cents per lb. and averaged 12 cents for the whole crop, the price of sugar has been gradually going down, chiefly owing to excessive planting of cane in Cuba and increased production of cane and beet in other countries. The average for 1922-23 was from 3·19 to 5·22 cents per lb., for 1923-24 from 3·26 to 5·18 cents and during the last crop from 2·00 to 2·69 cents, which latter price is considerably below cost of production for the crop.

DISTRIBUTION OF SUGAR MILLS GRINDING DURING THE YEARS 1922-23 AND 1923-24.

	1922-23.	1923-24.
Cuban owned	95	93
American owned	55	59
Spanish owned	26	20
Other nations	6	8
Number of mills grinding	182	180
	Tons.	Tons.
Cane ground	31,052,853	35,073,700
Sacks of sugar produced	25,259,357	28,472,101

(Sacks average 320 lbs.)

A point to be remembered when speaking of the economic running of sugar mills is the fact that many of the Cuban-owned mills are being worked by some of the American banks under judicial administration owing to the heavy indebtedness of the mill owners to the bankers. As some of the mills are very heavily mortgaged, it is not improbable that this administration will continue for some years to come.

We regret to notice the decease of Mr. WM. W. SIVEWRIGHT, New York representative of the Farrel Foundry & Machine Co., of Ansonia, Conn., U.S.A., who died in Santo Domingo City, on February 22nd. Mr. E. H. THOMAS, whose name is well-known in sugar circles, has been appointed as his successor, his offices being at 15, Moore Street, New York City. This Company has lately concluded arrangements with W. BOLEY, a well-qualified engineer of Calle Alsina, 748, Buenos Aires, to represent it in Argentina.

The Director of the Bureau of Standards, Mr. GEO. K. BURGESS, is advocating the production of levulose from artichokes in the U.S., believing that it offers the possibility of replacing ordinary sugar to a greater or less extent. He believes that if the price of levulose compared favourably with that of sugar, the demand for it, especially for confectionery manufacture, would be very large. "No development has occurred in many years that has such possibilities for influencing man's supplies of carbohydrates as the successful crystallization of levulose from water solutions achieved at the Bureau," he says.

Publications Received.

The Chemists' Year Book, 1926. Edited by F. W. Atack, M.Sc., F.I.C. Eleventh Edition. (Sherratt & Hughes, Manchester). 1926. Price: 21s., nett.

Since its publication in 1916,[1] this book has been revised from year to year, and enlarged somewhat, though now it is bound in one volume, instead of two, as originally. It is a general reference book for the chemist in the laboratory and in the works, and contains an immense amount of information in a readily accessible form. In addition to general chemical and physical data (constants, general properties of inorganic compounds, nomenclature of organic compounds, and general properties of organic compounds) there are sections on qualitative analysis, on reagents, on volumetric and gas analysis, and on spectrum analysis. Following this comes what is perhaps the most important part of the book, namely the condensed methods of technical analysis, covering the requirements of most industries. There is, for example, a particularly good section on "Agricultural Chemistry," by Sir E. J. RUSSELL, F.R.S., and H. J. PAGE, B.Sc., A.I.C.; and another summarizing the methods used in American practice by A. L. PRINCE, M.Sc., which two sections are excellent. That on "Carbohydrates," however, is a disappointing compilation. It does not even state the procedure for the polarization of a raw sugar; certain of the methods are not standard practice; the Clerget formula is incorrect; a table is given of "analyses of various cane sugar products" that is incomplete and out-of-date, and the information is open to criticism on other points. A section of "Sugars," giving modern standard methods of analysis as now used in cane and in beet factories, and in commercial work, would be a welcome addition to this reference book, in fact should certainly be present in it. Finally, there are data on weights and measures, hygrometric tables, logarithms, mathematical constants, etc., completing this volume. Notwithstanding our few critical remarks, the work is without doubt one which should be in the hands of all chemists.

The Life and Chemical Services of Fredrick Accum. By Chas. A. Browne. (Pamphlet reprinted from the *Journal of Chemical Education* of the American Chemical Society, 1925).

ACCUM, born at Bückeburg, Germany, in 1769, was a notable figure in scientific circles in London from about 1800 to 1820, when he established a considerable reputation of a teacher and popularizer of chemistry, Prof. BENJ. SILLIMAN, of Yale, Prof. WM. PECK, of Harvard, and Prof. JAS. F. DANA, of Dartmouth, being among his American students. He was an early advocate of gas lighting, a pioneer crusader against food adulteration, and a writer of a number of books on the chemistry of his time. ACCUM obtained in 1799 or 1800 from Germany the first beet sugar brought into England; and another connexion with our industry was as chemical expert in an action brought by Severn, King & Co., sugar refiners against the Imperial Insurance Co. for the payment of insurance, arising out of a fire which had destroyed the plaintiff's refinery at White Chapel, London. In this sugar-house had been installed a process using oil as the heating medium, this being circulated through the boiling pans; and the insurance company alleged that the apparatus was unsafe and had been introduced against their consent. Dr. BROWNE's pamphlet makes highly interesting reading for the student of the history of chemistry.

A Practical Handbook on Rat Destruction. By C. Leopold Claremont, B.Sc., F.I.C. (John Hart, London). 1926. Price: 3s. 6d.

Mr. CLAREMONT, when Chemist in Charge, Rat Research Department, Ministry of Agriculture, London, was engaged in investigations on the destruction of rodents, and then accumulated a considerable amount of information on the subject, which he has summarized in this small book. He discusses rats and their habits; the practical destruction of rats; rat poisons and how to use them; co-operation in rat destruction; rats and public health; and lastly deals with "The Rat Menace under Control." He describes fully what may be called the mechanical methods, such as hunting, trapping; and likewise chemical methods, such as the use of poisons in solid and liquid and gaseous form. In general the conclusion is that in the great majority of cases poisoning offers the simplest and most satisfactory way of dealing with rats, and particular attention is drawn to the use of red squill, which poison undoubtedly claims many advantages over most others, being for practical purposes harmless to larger animals, besides being readily presented to rats combined in many different sorts of baits. His book is certain to be of value to the sugar planter and factory manager troubled with the depredations of these rodents in the field or in the store, and should be in the possession of all such.

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[1] *I.S.J.*, 1916, 428; 1919, 404

Erwiderungen auf "Über Entfärbungskohlen im Allgemeinen und Über Carboraffin und Norit in Besonderen." (H. Zert and Fr. Nosek). By the Verein für Chemische und Metallurgische Produktion, of Karlsbad. Tagesfragen aus der Zuckerindustrie. (Albert Rathke, Magdeburg). 1926. Price: 1 mark (unbound).

This pamphlet, written by the manufacturers of "Carboraffin," is a reply to the recent publication in the same series written by ZERT and NOSEK,[1] who dealt with certain advantages possessed by the rival preparation, "Norit" We recommend its perusal to those interested to the controversy which is taking place on the Continent as to the relative merits of "Carboraffin," a very powerful carbon, which is used without revivification, on the one hand, and "Norit," a less powerful preparation, which, however, is used with repeated regeneration, on the other hand.

Trade Notices.

The CONSOLIDATED PNEUMATIC TOOL COMPANY, Ltd., forward illustrated literature describing their specialities, e.g., Portable Air Compressors, Electric Arc Welders, Little Giant Combination Hoists, Vertical Power-driven Air Compressors. These are fully illustrated, and size and capacity tables are included. The firm's address is 170, Piccadilly, London, W.1.

From the SUGAR MACHINERY MANUFACTURING COMPANY, Ltd., 76, Elsham Road, London, W.14, we are in receipt of two well prepared brochures describing and illustrating (1) the Maxwell Patent Crusher-Shredder (which has been fully described in our pages[2]) and (2) the Maxwell-Boulogne Patent Juice Scale[3] These will meet the needs of enquirers after these two specialities, and copies can be obtained on application to the firm in question.

The GEO. L. SQUIER MANUFACTURING COMPANY, the well-known American manufacturers of sugar, coffee, rice, and general plantation machinery, have recently acquired the full ownership of the Blymyer Iron Works Company, of Cincinnati, Ohio, a firm of similar activities. The Squier Company had already in its career absorbed the Buffalo Forge Company and the Buffalo Steam Pump Company, and its latest step will further strengthen the resources of the company in carrying out their slogan "From cane to sugar bag," in other words in turning out complete sugar factories, not only those of very large capacity but also the smaller types for which there has been a demand on the part of past customers. The headquarters of the enlarged firm remain at Buffalo.

Among new companies recently registered in the U.K. are:—Sugar Beet Dehydrating Co., Ltd., 27, Old Jewry, E.C. (Registered No. 212,641), Private; to carry on business as indicated by the title. Nominal capital, £100 in 1s. shares.

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[1] See *I.S J.*, 1925, 666.

[2] *I.S.J.* 1925, pp. 418–422.

[3] *Ibid.*, pp. 588 592.

Brevities.

Claim[1] is made in a recent patent by Erwin Schmidt, assignor to the Gesellschaft für Chemische Produktion, of Mannheim-Waldhof, Germany, for the use of activated charcoal for eliminating arsenic from hydrochloric acid.

In 1920, Hilo Sugar Co., T. H., put in a system of portable telephones enabling communication with any field in which harvesting is taking place, this being now considered almost an indispensable addition, though an inexpensive one, in keeping in touch with the mill.

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It is estimated that the present production of crystallized dextrose in the United States is in the neighbourhood of 2250 long tons per day. Commercial glucose (corn syrup) is the usual raw material, and the three producing companies are the Clinton Corn Syrup Refining Co., the American Maize Products Co., and Penick & Ford.

Soil alkalinity is known to be of importance in plant cultivation, but this alkalinity should be controlled, not by the ordinary titration methods, but by the determination of the hydrogen ion concentration, the optimum range recently found in the case of sugar beets being 7·2 to 7·6. On soils having a *pH* value above or below this range, smaller yields are obtained, other conditions equal.[2]

The British Sugar Beet Society announces that the Mason Challenge Cup has been awarded this year to Mr. Philip Last, Eye, Suffolk, grower for the Cantley factory, whose crop of sugar beet showed an average yield of 17·95 tons per acre with an average sugar content of 17·9 per cent. The competition was again open to all growers of not less than 5 acres for any of the existing factories.

William D. Horne, 30 years chief chemist of the National Sugar Refining Co., Yonkers, N.Y., has severed his connexion with that Company and is now connected with the Hershey Chocolate Co., dividing his time between New York and Cuba. Edgar Whitman Rice, whose connexion with the National Sugar Refining Co. has extended over a period of 16 years, succeeds Dr. Horne as chief chemist.

According to a patent, recently taken out by the Tokyo Imperial Industrial Laboratory,[3] sugar juice is clarified by treating with hypochlorous acid at 55°C.; or chlorine gas is led into the juice, and the free chlorine afterwards removed by distillation *in vacuo* or neutralized by the addition of an alkali. Alternatively, free chlorine may be generated in the juice by adding sodium chloride and subjecting the solution to electrolysis.

Strenuous efforts are being made in Argentina to impose additional import dues on foreign sugars, on a sliding scale calculated to come into force if local prices fall below $4·50 paper the 10 kilos in the Buenos Aires market. Political parties have taken the matter up. As an item of interest it may be mentioned that some hundreds of tons of sugar from Czecho-Slovakia are reported to have been landed in Buenos Aires and sold to Bolivian dealers, being forwarded northwards by rail, to all intents and purposes across the Argentine sugar-producing area. Current prices are $3 paper the 10 kilos on wagon in Tucumán for moist granulated, with $3·40 for refined (pilé)[4].

A steam meter is now on the market for which at least two distinct advantages are claimed. In the first place, it records immediately pressure is on the line, whereas there are other designs which commence to operate only after a certain flow. In the second place, it is adaptable, in that one meter can be attached here and there in the factory to record the amount of steam flowing along a pipe-line, suitable orifices being fixed at the desired points. In a sugar factory or refinery, the measurement of the steam flowing at a number of different points is desirable, and if meters were installed at all such points the cost would be a high one. But with the scheme here advocated, and an intelligent grading of connecting piping, the proposition becomes a practicable one, which should appeal to those concerned in fuel economy and general efficiency.

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[1] U.S. Patent, 1,571,648. [2] O. Arrhenius, *Zeitsch. Zuckerind. Czecho-Slov.*, 1925, **50**, *Rundschau*, 5.
[3] French Patent, 691,198. [4] Bank of London and South America *Monthly Review*.

Since giving last month corrected figures of the Australian sugar *per capita* consumption[1], when the Government Statistician's figure of 138 lbs. was reduced by the *Australian Sugar Journal* to 120·39 lbs. as the more likely figure, we learn that the official estimate has been reduced and is now finally put at 124 lbs. in terms of raw sugar.

The Mercidita "Suchar" (decolorizing carbon) refinery P. R., now operating, has a capacity of 250 short tons of sugar per day.[2] It is equipped with five "Auto" filters, each 500 sq. ft. area, and two "Windok" electric revivifying furnaces, having a daily capacity of 40 short tons of carbon. Part of the standard granulated made will be sold locally, the rest going to the New York market.

C. P. Wilson employs colloidal precipitation for the manufacture of pectin. Lemon refuse, extracted with water containing 0·5 per cent. of SO_2, is filtered through paper pulp, cooled, and treated with aluminium hydroxide, the reaction of the liquid being *pH* 4·0 to 4·2. The mixture of pectin and hydroxide is centrifuged, dried, comminuted, and the former extracted with acid alcohol. This method (recently patented) has been employed commercially, but is expensive.[3]

W. T. McGeorge,[4] has found (under the experimental conditions he describes) that aluminium salts exert a direct toxic action on sugar cane, manganese salts, on the contrary, having no effect. Resistance of the plant to aluminium toxicity was shown to be increased by increasing its phosphate or potash reserve; but phosphate applications are effective only over a short period, and heavy applications of potash are usually required. Lime gave no immediate response, though there was a greater residual stimulation of plant growth.

Galvanized corrugated iron sheeting for roofing is now being made with ridged slots at regular intervals along the top of each corrugation. This makes the sheeting more suitable for use in hot climates, in that it provides for uniform ventilation and an ample stream of light, even in buildings in which windows are absent, as in stores. This sheeting has been under test in England and Scotland during the last three years, and has (it is claimed) been proved to be weatherproof, "free from sweating, cool in summer, and comfortable in winter."

Dr. C. A. Browne, Chief, U.S. Bureau of Chemistry, at a recent meeting of the Montreal Section of the Society of Chemical Industry, said that the rise of the beet sugar industry had suggested that the day of the sugar cane was passing; but the cheaper production and greater yield of the latter plant assured its future. Nevertheless, the output of beet sugar was bound to play a beneficial part in crop rotations, and was important to national economy. Problems awaiting solution were the prevention of the loss of sucrose in cane before harvesting, and the question of dehydration.

In the realm of liquid fuel production, the most absorbing phase of recent developments is the process (which is now feasible, not only technically, but also commercially) for producing substances, such as synthetic methyl alcohol, more commonly known as "Methanol" from water gas[5]. . . . . The process consists essentially in the passage of purified water gas having the composition approximately of 60 per cent. hydrogen and 30 per cent. carbon monoxide at a pressure of 200 atmospheres over a catalyst maintained at a temperature of about 400° C. . . . . The possibilities of effecting modification of the products yielded are enormous, and Prof. Franz Fischer has elaborated the Methanol process so as to produce a mixture of higher alcohols and ketones which he has called 'Synthol' . . . . .[6] It is reported that something like 20,000 tons annually of "Methanol" is now being produced in Germany by the Badische A. & S. F., and that its cost of production is 10-13 pfennigs per litre, though the selling price to German consumers is maintained at 48 pf. It is being used at present mostly in the manufacture of dyes.[7]

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[1] *I.S.J.* 1926, 124.
[2] *Facts about Sugar*, 1926, 21, No. 4, 83.
[3] Refer also to *American Vinegar Industry*, 1923, 2, 14.
[4] *H. S. P. A. Bulletin*, 1925, 49.
[5] See also *I S.J.*, 1926, 79
[6] *The Times Trade and Engineering Supplement*, January 23rd, 1926, p. ix.
[7] *Chemical Trade Journal*, 1926, 78, No. 2026, 346.

Review of Current Technical Literature.[1]

COVERING WITH EXHAUST STEAM IN WHITE SUGAR MANUFACTURE. *A. Wassing.* *Archief, 1925, 33, No. 4, 69-72.*

Experiments were carried out during the 1923 crop at the Soerawinangoen factory, Java, on the covering with exhaust steam in the production of white sugar, and so encouraging were these that all the machines of the battery were equipped for this method of working.[2] In using exhaust steam in this way, the layer of sugar in the centrifugal is much more quickly raised to a certain temperature than with superheated steam ; whilst the condensed drops of water in a very fine state of division are powerfully forced through the crystals, thus forcing out the particles of adhering molasses. A line of 4 in. piping is arranged at the rear of the machines to bring the exhaust to the installation, and this is tapped by 1 in. piping (say by T-pieces intermediate between each machine), this piping entering the machine in such a way that the nozzle is over the cone, and not directly against the layer of sugar, otherwise a good part of the grain would be dissolved in quite a short time. In order to obtain the best results, the following points must be observed : After all the molasses has been swung out of the massecuite, the crystals are washed with 1 litre of water for each 36 in. machine ; and then, when it has been slowed down, just before it comes to rest, the exhaust steam is applied. A sharp supervision must be exercised over the workmen, who, at first at any rate, are inclined to leave the steam on for too long, and it is advisable to make use at each machine of a sand-glass running out in 4 mins. So long as the steam is on, the centrifugal must remain entirely closed, otherwise cold air is given opportunity to enter, causing the sugar to become hard. Compared with superheated steam, it is true that the work is hotter and harder ; so it is convenient to have the machines lagged, and to cause the men to wear rough gloves made out of old filter-press cloth when discharging. As to the pressure of the steam, this should be at least 5 lbs., and it has been found by experience that 7 lbs. gives good results. It is of some importance to use a large, regular grain for this method of operating. Irregular crystals or false grain means that more water must be used than is desirable to obtain a superior product during the same time of covering by steam. As advantages of this *modus operandi*, it is claimed (1) that less crystal is washed out, to thus return to the pans ; (2) that the capacity of the battery is quite appreciably increased, covering with superheated steam, for example, requiring on the average 10·5 min., and with exhaust only 7-8 mins. This being made up as follows : Filling machine, 1 min. ; drying, 1-1½ min. ; steaming, 4 mins. ; and discharging, 1 to 1½ min. ; and (3) that fuel is economized, as a superheater is no longer used for this purpose.

MILLING AND BOILER-HOUSE CONTROL RESULTS IN JAVA FOR 1925. *Ph. van Harreveld.*[3] *Archief, 1925, 33, No. 51, 1386-1389.*

Nearly all the factories of Java contributed in 1925 to the Mutual Milling Control, and the following are the average figures for the juice lost per 100 of fibre,[4] and the extraction obtained by them :—

	Juice lost per 100 of Fibre.				Sugar Extraction.			
	1922.	1923.	1924.	1925.	1922.	1923.	1924.	1925.
3 mills	66	64	62	57	90·2	90·5	91·2	92·0
3 ,, + c.	59	57	56	50	91·2	91·5	92·2	93·2
4 ,,	53	52	48	45	92·1	92·5	93·2	93·9
4 ,, + c.	49	46	46	41	93·1	93·5	93·6	94·6
5 ,,	—	—	—	29	—	—	—	95·9
5 ,, + c.	—	—	—	20	—	—	—	97·4

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] Which is not new, so far as beet sugar manufacture is concerned.

[3] Director of the Java Sugar Experiment Station.

[4] *I.S.J.*, 1923, 140 ; 1924, 665.

Following is a tabulation showing the number of factories using different milling installations during the years 1922-1925, *m* indicating mill, and *c* crusher :—

	3 *m*	*c* + 3 *m*	4 *m*	*c* + 4 *m*	5 *m*	*c* + 5 *m*
1922	38	46	25	53	—	—
1923	31	42	28	53	—	—
1924	31	35	35	70	—	—
1925	23	23	40	90	1	1

One of the factories, namely Tjebongan, equipped with a crusher and five mills had remarkably low figures indicating sugar left in the bagasse, equivalent to only 20 parts of juice per 100 of fibre. Regarding the calories consumed per kilo of cane,[1] this was 617, 610 and 613 in 1923, 1924, and 1925 respectively; whilst the fibre content was 13·1, 12·9, and 12·8. An automatic apparatus for the analysis of the flue gases has increasingly been put into operation, and has contributed an economical consumption of fuel. Considering that a number of factories now have a surplus of bagasse, opportunity is thus given to utilize it for the manufacture of "Celotex," but this material is very combustible; it would be desirable to combine it with cement or other material, which, moreover, would make it stronger. Searby shredders between the first and the second mill in Gesiekan and Delanggoe factories fulfilled expectations, and are now in regular working. Experiments on hot maceration at Pleret factory have not been continued, seeing that it now appears that such apparatus would require a greater distance between mills than can be arranged in most Java factories. A small and cheap bagasse scale has been constructed under the direction of the Administrator of the Medarie factory, so as to allow of the weighing of the bagasse for each boiler. It appears to work well. A new type of furnace having as its object the diminution of slag formation has been designed by the Experiment Station, this combining the advantages of some existing Java furnaces, and resembling in some respects certain Hawaiian types. It has been installed at the Medarie, Pandaan, Balapoelang and other factories. NOBEL'S new automatic feed water meter has been used at the Pandaan factory with satisfactory results, and appears to give particularly accurate indications. Its installation generally would greatly further steam production efficiency.

GENERAL CHEMICAL CONTROL RESULTS FOR JAVA FACTORIES DURING 1925. *Ph. van Harreveld. Archief, 1925, 33, No. 51, 1390.*

Total sugar losses in bagasse per 100 of polarization in the cane averaged 15 2 in 1925 for 165 factories, being 16·5 per cent. in 1924 for 164 factories; this total loss of 15·5 being distributed among the factories in the following way:

	PER CENT.													
Total losses.. ..	9	10	11	12	13	14	15	16	17	18	19	20	21	22
No. of factories ..	4	9	4	10	22	19	16	21	23	16	13	3	2	3

Eight of the factories had a loss in the molasses smaller than 4·5 per cent. of the polarization introduced into the raw juice; and the same number, on the other hand, lost more than 10 per cent. Only one factory, namely Delangoe (No. 110 on the list, a carbonation house) had a molasses having an average sucrose purity lower than 30, namely 29·1. Losses in the manufacture per 100 of polarization in the cane were averaged in the following way:

	CARBONATION. Per cent.	DEFECATION. Per cent.	SULPHITATION. Per cent.
1925 in 165 factories	7·5	8·7	10·1
1924 in 164 „	7·7	9·3	10·4

from which it is clear that sulphitation factories, filtering only a part of their juices through presses are rather behind the carbonation method in respect of yield, in which all the juices are filtered. Following is a table giving the losses since 1917 of sugar in bagasse and in the rest of manufacture :

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[1] *I.S.J.*, 1924, 444.

	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925. (to 30th Sept.
	PER CENT.								
In bagasse	8·8 ..	9·0 ..	9·0 ..	8·6 ..	8·5 ..	8·2 ..	7·8 ..	7·1 ..	(6·1)
In manufacture ..	9·8 ..	9·0 ..	10·4 ..	9·3 ..	9·6 ..	9 8 ..	8·6 ..	9 4 ..	(9·0)
Total manufacture.	18·6	18·0	19·4	17·9	18 1	18·0	16·4	16·5	(15·1)
Recovered in products	81·4	82·0	80·6	82·1	81·9	82·0	83·6	83·5	(84·9)

— — —

PORCELAIN DISHES FOR THE DETERMINATION OF ASH IN SUGAR PRODUCTS, ETC. *Anon.* *Communicated by the Makers of the Apparatus.*

Dishes made of a special quality of hard porcelain are now being recommended for the ashing of sugar factory products, etc., these resisting reasonably the action of sulphuric acid during carbonization and that of the alkali carbonates during incineration, and otherwise answering all the requirements of such analyses. Their size, 5 cms. (2 in.) diam. at the top and 2 cms. (about ¾ in.) height, is somewhat larger than is usual for platinum dishes, but their weight is only a little more. In carrying out a determination of ash it is recommended that after mixing the sugar product with the sulphuric acid the dish be immediately placed in the muffle, instead of preliminarily heating over a naked flame, as is very often done. Incineration proceeds in these dishes as quickly as in platinum ones, and, as the porcelain is of a grade that is particularly resistant to heat, there need be no fear of cracking. They are quite cheap, and should find considerable use in sugar factory and refinery laboratories if the claims of the makers can be substantiated.

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EXPERIMENTS ON THE SOLUBILITY OF METALS IN ACID SUGAR SOLUTIONS. *K. K Jarvinen.* *Zeitsch. fur Untersuchung der Nahrungs u. Genussmittel, 1925, 50, 221–225.*

In previous work on this subject made with kitchen utensils, the author obtained inconclusive results.[1] Now his method of procedure is to submerge thin strips of metal, 7 cm. × 7 cm., and about 1 mm. thick (a total surface therefore of about 100 sq. cms.) in 100 c.c. of solution contained in cylinders immersed in a boiling water-bath during three hours any evaporation being compensated. Actually three different solutions are used, these being : (1) a 5 per cent. solution of common salt ; (2) a 1 per cent. solution of hydrochloric acid ; and (3) a solution of 400 grms. of sugar and 15 grms. of citric acid in 1000 c.c. But here only the results for the third named, that is, the acid sugar solution are reproduced, these results being expressed in mgrms. of the metal dissolved from 100 sq. cms. during three hours at or near boiling point.

AMOUNTS DISSOLVED.

Metal used.	Copper.	Zinc.	Tin.	Other Metals.
Copper	20 ..	— ..	— ..	—
Tin	— ..	— ..	16 ..	—
Zinc	— ..	45 ..	— ..	—
Nickel	— ..	— ..	— ..	33 nickel
Iron	— ..	— ..	— ..	59 iron
Aluminium	— ..	— ..	— ..	46 aluminium
Brass	2·7 ..	1·2 ..	— ..	—

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[1] *Ibid.*, 1923, 46, 183–190.

ALCOHOL MOTOR FUEL IN THE P. I. *C. M. Hudson. Reports of the Third Annual Convention of the Philippine Sugar Association, 1925.*

Most of the alcohol motor fuel made in the P I. is consumed by the sugar planters, who have not, however, adopted tractor ploughing to the extent that it is taken up in other countries. Nevertheless, during 1925, the quantity of 2,424,872 proof litres of Foster spirit was produced locally. Recent tests made in the Islands have shown that it takes about 15 per cent. more motor alcohol than gasoline to run internal combustion engines which have been designed and adjusted for the latter fuel; but it has also been found that with proper carburettor adjustment, and by increasing the compression in the cylinders, equal or even better mileage can be obtained with the new fuel. A recent test made in Manila, with a new "Fordson" tractor burning alcohol demonstrated that by slightly increasing the compression in the cylinders of the engine a gain in power and a fuel saving of about 10 per cent. resulted. Similar results have been obtained by the Calamba Sugar Estates , whilst the Ma-aa Sugar Central has used alcohol in a gasoline locomotive with eminently satisfactory results. When new high compression engines come to be built, one can expect to almost double the mileage now being obtained with alcohol. Advantages of alcohol in motor ploughing have now been so clearly demonstrated that it is believed that the sugar planters of the Philippines will put more tractors operated by Foster alcohol motor fuel into operation, so as yet further to increase the production.

REMARKS ON DE VECCHIS BEET DESICCATION PROCESS. (*A*) *J. de Grobert. Journal des Fabricants de Sucre de France, 67, No. 10, March 6th, 1926.* (*B*) *Alex. Herzfeld, Ibid., 67, No. 11, March 13th, 1926.*

(*A*) About 25 years ago LAFEUILLE at the San-Luis Refinery, Barcelona, installed a small drying plant for dehydrating beets, but the drying was hopelessly irregular, and the syrup obtained by extraction in a diffusion battery was highly coloured and of a relatively low purity. Next in the field is Dr. INEO DE VECCHIS, who at Viterbe, Italy, applies a special method of desiccation for which he claims favourable results in respect of dehydration without loss of sugar and good exhaustion by diffusion, this being said to be due to the coagulation of the albuminoids and to modifications undergone by other organic matters under the prolonged influence of heat during the drying. But DE VECCHIS does not say which are the organic matters that are thus favourably affected, nor does he give any experimental results in support of his hypothesis. As to the claim that the coagulation of albuminoids enables one to use a lower temperature during diffusion, there is nothing special in this, as it is known that in diffusion with ordinary fresh slices 96 per cent. of the albuminoids can be recovered in the exhausted pulp by using a high temperature (at least 80°C.) in the first vessels of the battery, a temperature which in fact is often surpassed in modern work, especially in the Naudet process. Anyway, the advisability of coagulating the albuminoids preliminarily in this way is questionable, since they are known to have adsorbent properties in clarification, so that if they are absent it is necessary to use an extra quantity of lime. Drying plants for beets were operated in France before the war, the dehydrated product being delivered as horse fodder in the form of dried chips or of meal, but since the substitution of automobile for animal traction this enterprise has ceased to exist. Nevertheless, the result of its vogue was to improve such drying apparatus until they have become almost perfect, the drying being regular, the product homogeneous, alteration of sugar obviated, and the operation smooth. Desiccation of beets for the purpose of extracting sugar from them was made the object of an inquiry in France in 1915-16 by Mr. CLEMENTEL, Minister of Commerce. A subcommittee composed of MM. FERNBACH, DE GROBERT, and MANOURY reported dehydration to be capable of realizing a greater profit owing to the reduction of the cost of manufacture and the lessening of general expenses, these being spread over the greater tonnage worked. However, the cost of an installation of a capacity to sufficiently prolong operations after the termination of the campaign proper was found rather considerable, besides which the construction of stores was necessary, the whole demanding the outlay of an additional amount of capital to be remunerated and amortized. It is thus seen (the author of this article concludes) that the question of the manufacture of sugar from dehydrated roots is very complicated; and that, even granting it is technically solved by Dr. De Vecchis' process, or by some other, there yet remain unsolved problems of an economic order, the degree of which will vary according to the particular conditions of any case considered.

(*B*) Among the principal remarks of Prof. Dr. Herzfeld, Director of the Institut für Zuckerindustrie, of Berlin, are that De Vecchis' German patent does not refer to the drying of the beets (on which subject, in fact, the only remark in the English patent is that one should employ temperatures varying between 90 and 100°C.), but confines itself only to the defecation of the juices with lime and phosphoric acid. He reviews previous experiments on beet dehydration, viz., those of Schüzenbach,[1] Konrad Trobach,[2] and Wiechmann[3] Then he recalls that a little after the war during the period of inflation of prices a brewery near Löbau (Saxony) operated a process for making syrup from dried beets, this product at that time being exempt from excise, though this is no longer so. These syrups were of an agreeable taste, which did not require any subsequent purification, and served as the raw material for the brewing of excellent porter. But the German sugar industry had no interest in this undertaking; and as for the De Vecchis process this is pronounced as being "still insufficiently developed to succeed on the Continent." One of its drawbacks is the necessity of using the costly defecation scum in agriculture, where it meets with severe competition from superphosphates and Thomas meal. Its exhausted slices can be utilized in their fresh state only for a short time, since they do not preserve well in silos, and require to be dried if they are to be utilized to advantage. If the dehydrated beet process is to be practised, it is desirable in Prof. Herzfeld's opinion, to wait until the price of alcohol is sufficiently low, since by its use one solves most conveniently, not only the question of the residuary waters, but also that of the utilization of the resulting molasses for the preparation of the necessary spirit.

Beet Factory Chemical Control in the U.S.A.

J. J. Sheehan *Institute of Chemistry, Journal and Proceedings, 1926, Part 1, 30-31.*

In a lecture given before the Irish Section of the Institute, the author described his experience in one of the 10,000-ton beet factories in the United States, where the personnel of the control laboratory consisted of 10 chemists working in 3 shifts of 8 hours each, night and day, 7 days a week, over a campaign of 100 days, the number of laboratory control tests carried through in the campaign being about 21,700. To achieve efficiency in control, labour and time-saving devices had been installed in the laboratory to an almost extreme degree. Reagents in bottles were practically obsolete, supplies of all necessary solutions, distilled water, and water at 20°C. being "on tap" at each working bench. Should a laboratory test show that some process in the factory was working unsatisfactorily, the chemist immediately pulled a string which caused a bell to ring over the particular plant at fault, the bell continuing to ring until the foreman-in-charge had rectified the trouble, and a subsequent test showed the process to be proceeding normally.

Determination of Reducing Sugars volumetrically using Fehling's Solution, and Dianol Green as Indicator.

Jas. S. Mann. *Chemistry and Industry, 1926, 45, No. 11, 187.*

After using this method, fully described by Lane and Eynon,[4] for over twelve months in the examination of a great variety of sugars and syrups both from the beet and the cane, the results have been found to compare so very closely with those obtained by the usual volumetric method that there should be hesitation (in the author's opinion) in substituting it for the latter, over which it has many decided advantages. There is one drawback, however, to the new method: viz., that "back oxidation," mentioned by the authors, takes place so very rapidly, even when using a flask with a neck of less than

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[1] Stammer's "Traité de la fabrication du Sucre," Première edition, 1874; deuxième edition, 1887. [2] German Patent (use of alcohol being described for extraction).

[3] *Sugar*, June, 1915. See also *Centr Zuckerind.*, 1914-15, **23**, 1002. *Vereins-Zeitschrift*, 1915, 311. *Centr. Zuckerind.*, 1915-16, **24**, 146. [4] *I.S.J.*, 1923, 143; 1924, 107.

¼ in. internal diameter, so that unless the operator is capable of making a quick decision the result remains in doubt. After trying various expedients he came to the conclusion that the best way to eliminate this difference was to substitute an indicator which, whilst showing a sharply defined point, as in the case of methylene blue, does not so readily re-oxidize. This, he thinks, has been found by one of his assistants, J. D. ATKINSON, who suggested the use of Dianol Green. This has been tried as an internal indicator in comparison with methylene blue, and in all cases it has been found that the end-point once indicated remains sharply defined for an indefinite period, constant results being obtained.[1]

VARIATION OF INDIVIDUAL SUGARS IN THE JERUSALEM ARTICHOKE DURING GROWTH. *S. H. Collins and R. Gill. Journal of the Society of Chemical Industry, 1926, 45, No. 11, 63-65T.*

As a result of extensive investigations into the sugar content of oat-straws, it was found that wherever much sugar is present, three-fourths of the total sugar is levulose.[2] In order to explain this preponderance of free levulose, it might be assumed that in the living plant sucrose is the form in which carbohydrate is transferred from leaf to stem and to the other parts of the plant, this sucrose then undergoing hydrolysis into its constituent parts, dextrose and levulose. This dextrose is used up for the formation of tissue (cellulose); and, in the case of oats, in the production of starch in the grain; whereas the levulose is not required by this plant for such purposes, and is hence left behind in the free state. No doubt the plant will utilize some of this levulose for the energy required for plant growth, but the quantity of sugar used in this way will not compare with that used for deposition of starch plus cellulose-formation. In view of the above results, it was determined to trace the various sugars in a different kind of plant during its growth, and *Helianthus tuberosus* was chosen, in view of the fact that its carbohydrate reserves take the form of condensed levulose (inulin) in the tuber. Of course, the oat and the Jerusalem artichoke are of entirely different characters, for in the former the reserve food is stored in the grain, and the latter in the root; but it was not possible to investigate a cereal plant where inulin replaces starch. Samples of the growing plant and of the tubers were taken at intervals, and the sugars determined in these. Results were obtained indicating that in the stalks the sucrose and levulose rose to a maximum during growth, falling away in the last stage of the life of the plant. Dextrose was the principal sugar in the earliest stage, later remained at a fairly constant figure, and finally again became the principal sugar. This result is significant when compared with the figures for the oat-straws in a similar state of life where levulose is the chief sugar present. It appears then as if the plant abstracts that particular hexose required for its storage material, the excess of the other remaining, indicating that both hexoses (dextrose and levulose) originate from the parent sucrose.

TURBIDIMETER. *John R. Baylis. Industrial and Engineering Chemistry, 1926, 18, No. 3, 311-312.* Principle of the instrument (fully described with drawings) is to observe liquid under examination in long-glass tubes illuminated by a blue light beneath, any matter in suspension reflecting white light rays, cutting out some of the blue. A turbidity of 0·1 part per 1,000,000 can be detected, and the method is made quantitative by the observation of standards prepared with increasing amounts of fuller's earth in suspension.—GROWTH OF CRYSTALS. *Cecil H. Desch.*[3] *Chemical Trade Journal, 1926, 78, No. 2026, 351.* "Growth is not a continuous process; but a face (of a crystal) grows in steps, a thin layer being added all over the face, of uniform thickness, followed by another similar layer, and so on. . . . . A layer, one atom or molecule thick, is first produced by atoms or molecules which become attached to the surface, the process being identical with that which the physical chemist calls adsorption. These atoms have some freedom of movement, and in the course of that movement some re-arrangement may occur, giving rise to two dimensional crystalline nuclei. The whole layer then becomes crystalline and a new layer is thus added to the face, on which further adsorption can proceed."—SUGAR BEET NEMATODE. *Asa C. Maxson. Through the Leaves*, March, *1926, 125-130.* This is a very complete account of the nature, development and control of this pest of such danger if not handled intelligently.—THEORY OF ACTION OF ACTIVATED CARBONS. *P Honig. Chemisch Weekblad, 1926, 23, 66-68.* Differences in the adsorbing quality of activated (decolorizing carbons) are believed to be due solely to their physical nature, mainly their porosity, and also to the nature and amount of impurities ; but not to differences of molecular structure, nor to the existence of aliphatic and aromatic carbons, as certain writers allege.—HYDRATION OF LIME. *W. G. Whitman and G. H. B. Davis. Industrial and Engineering Chemistry, 1926, 18, No. 2, 118-120* —Coarse inferior hydrate was formed when the rate of hydration was slow, and time was allowed for crystal growth, excess of water, reasonably high temperature, and agitation all favouring the formation of a fine product. Best results was obtained by dehydrating with a large excess of water in boiling solution.—H. I. C. IN BEET WORK. *R. T. Balch. Sugar, 1925, 27, No. 12, 587-590.* Electrometric and colorimetric methods are reviewed. Of the former, the use of tungsten or similar electrodes in conjunction with a recording potentiometer appears to be most promising, as there is a possibility of establishing the automatic control of carbonatation processes with such equipment. An attempt was also made to find suitable indicators that could be used in the various colorimetric methods for the *pH* range between 9·5 and 14·0. Only 3 dyes out of 21 tested might possibly have an application, namely, tropaeolin o (resorcin yellow), Schultz, No 143, *pH* range, 11·1–12·4 ; thymolphthalein, 9·3–10·6 ; alizarin yellow GG No. 48, 10·0–11·6. Of these the first is pronounced "entirely satisfactory" in respect of stability of standards and stock solutions, the others being less so.—BEET SUGAR FACTORIES IN FRANCE, THEIR PRODUCTION, EQUIPMENT AND COST OF OPERATION. *Circulaire hebdomadare Comité Central des Fabricants de Sucre de France, 1926, 38, Nos. 1929, 1930, and 1931.* Here very full data are given of the various beet factories in the different departments of France, statistical and technical.—THE LAFEUILLE CRYSTALLIZER IN BEET FACTORIES. *M. Roppe. La Sucrerie Belge, 1926, 45, No. 13, 230-233.* An appreciative article of this new crystallizer by the Manager of the Sucreries de Quévy-Peronne, under whom it has been under close supervision, his conclusion being that "the incontestible qualities of the Lafeuille crystallizer permit the auguration of a brilliant future to the apparatus, its only fault, inherent in its design, being the price of its construction, though one hopes that the makers and inventor may be able to ameliorate this."—TREATMENT OF BEET MOLASSES WITH ZEOLITES. *F. R. Bachler. Industrial and Engineering Chemistry, 1926, 18, 180-182.* By treating molasses solutions with zeolites (removing potassium and sodium in exchange for calcium salts) previous to using the Steffen process of exhaustion, a higher recovery of sugar was obtained (viz., 96·46 compared with 93·2 per cent.)—A NEW HAND REFRACTOMETER. *H. Schulz. Vereins-Zeitschrift, 1926, 25-29.* This small instrument is more accurate than the usual larger type for dilute solutions, and reads ordinarily to one unit in the 4th decimal plate, though with special precaution one can read to 3-4 units in the fifth, the range of scale being 1·330 to 1·376.—SUGAR LOSSES IN BEET FACTORIES. *W. Gredinger. 1925, 50, 1597-1598.* Known and unknown losses of sugar in the factory in 1924-25 were 0·37 to 0·38 per cent., but in factories in which the chemical control was inadequate the total losses reached 1·4 or 1·5.—ELECTRIC DRIVE FOR CENTRIFUGALS. *S. Hopperwieser. Centr. Zuckerind.. 1925, 33, 1532-1533.* Construction of the Brown-Boveri alternating electric motor is described in detail. For it, it is claimed that centrifugals can be accelerated and slowed down in the minimum time and with the minimum expenditure of power, and also with less wear than ordinarily.—MOISTURE ABSORBING QUALITIES OF SUGARS. *B. Hoche. Centr. Zuckerind., 1925, 33, 1557-1558.* Experiments on the hygroscopicity of various grades and finenesses of sugars lead to the conclusion that the relative humidity of the aid in stores should not exceed 70° C.

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[1] Tests carried out to examine the value of Dianol Green showed that its end-point was not as sharp as obtained with methylene blue, though "back-oxidation" was somewhat slower. Wool Green, recommended by the makers of Dianol Green as preferable by reason of its higher purity, gave no better result nor did a Violet dye. Methylene blue, therefore, would still appear to be the best "internal indicator" for the Fehling test.—*Editor.*

[2] *Cf.* S. H. COLLINS, *J.S.C.I.*, 1922, 56-57T.

[3] In a lecture before the Royal Institution of London, March 16th.

J. P. O.

Review of Recent Patents.[1]

UNITED KINDGOM.

Production, Revivification, and Application of Activated (Decolorizing) Carbon. (*A*) *H. E. Potts* (*Naamlooze Vennootschap Algemeene Norit Mij.*, of Amsterdam, Holland). *245,912*. February 22nd, 1924. (*B*) *Fabrikenvorm. F. Bayer & Co.*, of Leverkusen, Cologne, Germany. *246,110*. November 26th, 1925; convention date, January 13th, 1925. (*C*) *J. G. Aarts*, of Dongen, Holland. (*a*) *246,130*. January 7th, 1926; convention date, January 14th, 1925. (*b*) *246,132*. January 8th, 1926; convention date, January 14th, 1925,

(*A*) Gases or solutions are treated to remove impurities or constituents therefrom with an activated carbon having a high percentage of elemental carbon, a specific gravity (determined in ether) of not less than 2·0 and a heat of absorption for benzene of at least 40 calories per grm. of carbon. It may have an organized structure derived from the vegetable raw material used to make it, an apparent specific gravity of less than 0·1, a moisture absorption capacity (at ordinary temperature in an atmosphere of relative humidity 60) of at least 20 per cent., and an iodine absorption capacity whereby more than 80 per cent of the iodine in 50 ccs. of decinormal solution is absorbed by 500 mgrms. of carbon. Such carbons may be prepared by the processes described in U.K. Specifications 228,582, 228,812, 228,954, and 230,293. In an example of preparing a suitable carbon they are fed to a retort filled with staggered rods crude oil and air sufficient to provide good combustion without excess of oxygen and sufficient to produce a temperature of 1000-1200° C. in the activating zone, superheated steam at a pressure of 2-3 atmospheres and granules of dry-distilled pine wood charcoal at a rate of 10 kgs. per hour, a suction draft of 6 mm. of water being provided at the discharge ends. Sugar solutions and juices may be purified by means of the carbons. In an example, a washed raw sugar solution is treated at boiling temperature with a carbon of the above-described properties preferably prepared from pine or other coniferous wood and having an apparent specific gravity of less than 0·1, the mineral constituents having been removed by means of hydrochloric acid.

(*B*) Materials which are pasty or have a tendency to become so on heating, e.g., sawdust, peat lignite, ground bones, etc., impregnated with acids, salt solutions or alkalis, are prevented from adhering to the sides of retorts, etc., during carbonization by subjection to pressure, e.g., in a wire-cutting press or a briquetting machine before being charged into the retorts.

(*C*) (*a*) Complex materials containing carbon, such as coal, lignite, etc., are distilled, and carbon monoxide produced from the resulting coke is converted into finely subdivided carbon with or without the use of a catalyst. (*b*) Voluminous elementary carbon having a high degree of fineness and obtainable by decomposition of a gas containing carbon compounds is used as a fuel, preferably in an internal-combustion engine in such a manner that its potential energy is converted into external work.

Mill Rollers having a Grooved and Toothed Peripheral Face. *Francis Maxwell*, of Wallington, Surrey. *244,153*. September 5th, 1924.

Rollers are provided with curved grooves and teeth or ridges constituting a wavy structure, which may be continuous or interrupted. As at present, the general direction of the grooves and ridges or teeth is helically, axially, circumferentially or otherwise disposed; but, in every case, a positive waviness is superimposed on this general direction, whereby the stripped cane is gripped more effectively and pressed out of its straight shape

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. 2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each. *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin Germany.

and is thereby distorted, bruised and defibrated more effectively than in the known constructions. Free and efficient extraction of the juice accrues in consequence. The ridges between the grooves are notched so as to form communicating passages from groove to groove for gripping the cane, and for permitting the flow of the juice, the notches being constituted as cross-cut grooves relatively to the other grooves. Thus the latter grooves may, conveniently, be termed the principal grooves, and the others the subsidiary grooves. The subsidiary grooves may be arranged to take any desired course or direction; preferably, however, they are directed along straight wavy or curved or staggered lines or paths which may be continuous or interrupted. Rollers in which the invention is incorporated may be utilized in the same services as the known rollers. Fig. 1 shows a roller particularly applicable for initially crushing the cane, the principal grooves *C* and ridges *D* running circumferentially; the subsidiary grooves *E* may run obliquely and reversely as shown, or axially in staggered relation, or circumferentially, etc. In Fig. 2, the principal grooves *C* and subsidiary grooves *E* are counterpartal and run helically in two interesting series of opposite hands. In another arrangement, the principal grooves and ridges run, relatively to the circumferential medial line, helically right and left handedly, while the subsidiary grooves or notches run in staggered rows transversely thereto. Fig. 4 shows a roller with its surface sub-divided by the grooves *E*, which follow a continuous wavy path, into geometrical patterns, areas, or sections bearing the short grooves *C* and ridges *D* which are diversely directioned and positioned. Or the principal grooves and ridges may run axially, and the subsidiary grooves or notches be irregularly staggered. Fig. 6 shows a roller for use in a later mill of a train of mills, the grooves *C* and ridges *D* running circumferentially while the grooves *E* run axially in a broken wavy line.

FIG 4.

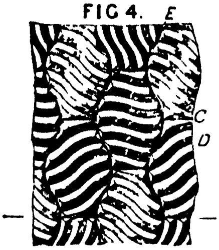


FIG 6

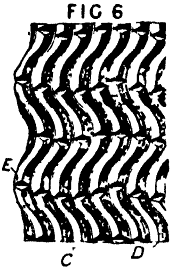


FIG.2

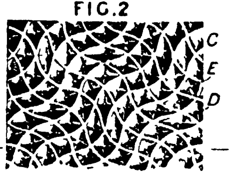
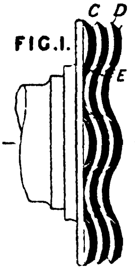


FIG.I.



MASSECUITE AND CRYSTALLIZATION CURING.* *F. Kessler*, **of San Fernando, Argentina.** ***245,712.*** **March 25th, 1925; convention date, January 7th, 1925.**

Sugar-syrup is passed through a series of horizontal crystallizing tanks to a centrifugal separator, the syrup being discharged from the bottom of each tank and fed to the bottom of the next. Stirrers, preferably formed of worms of opposite hand, work the syrup across the tanks in zig-zag courses. As shown, syrup is fed from a container *a* to a tank d^1, an agitating screw comprising opposite-handed sections f^1, f^2 passing the syrup in the direction of the arrow, Fig. 2. Syrup is then fed successively to similar tanks d^2, d^3, d^4, being finally passed to centrifugal separators by a pump *h*. A sampling faucet and a thermometer are fitted between each tank, and syrup or water may be fed to the tanks from storage tanks *k*. As shown in Fig. 3, the separators which may be fitted between the tanks, comprise screw-conveyors *n* held clear of the walls of the containers *p* by wire spirals *r*, separated syrup being discharged from apertures *o* in the container-bottoms.

FIG I

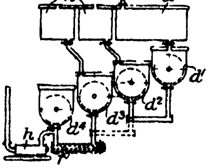


FIG 2

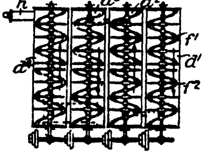
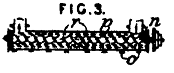


FIG.3.



MILL ROLLER CONSTRUCTION. *Charles Day and David M. Semple*, of 45, Scotland Street, Glasgow, Scotland. *244,832*. September 25th, 1924.

Experience has shown that with the present construction of mill rollers the juice works its way between the shell and the shaft and ferments, causing the corrosion of the shaft and of the shell, and destroying the fit. It has heretofore been proposed to seal the ends of such rollers hermetically by means of rings at the ends of the rollers welded by an oxy-acetylene welding or other process to the roller and to the shaft. In this present invention the shell is directly sealed and welded to the shaft by weld metal. Thus, the outer end of the shell may be grooved where it is in contact with the shaft or gudgeon, and the groove filled with weld metal by a process of electric or oxy-acetylene welding, making a continuous joint between the gudgeon or shaft and the shell. Alternatively, the shaft or gudgeon may be grooved, or the junction between the shell and the shaft or gudgeon may be welded without grooving. The described sealing of the shell directly to the shaft or gudgeon strengthens the attachment to the shaft, and suffices to prevent rotative or endwise movements of the shaft in the shell, without the need of keys or hoops. As compared with the proposal to weld sealing rings to the rollers and weld these rings to the shaft, by this invention the employment of such sealing rings at the ends of the roller is dispensed with and the area to be welded and the cost are reduced; in addition the weld is applied directly at the point to be sealed. Figs. 1 and 2 of the accompanying drawing are longitudinal sections of rollers embodying the invention. As shown in Fig. 1, the outer end of the shell *1* where it is in contact with the shaft or gudgeon *2* is grooved and the groove filled with weld metal as shown at *3*, making a continuous joint between the gudgeon or shaft and the shell *1*. As shown in Fig. 2, the shaft or gudgeon *2* is welded directly to the shell *1* without grooving.

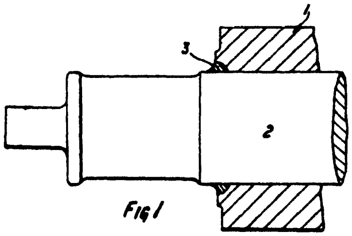


Fig 1

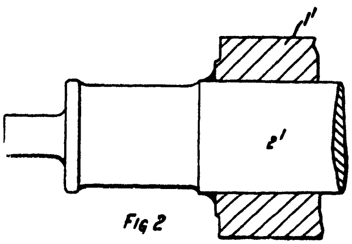


Fig 2

EDGE FILTRATION OF LIQUIDS. *Aktiebolaget Separator*, of Stockholm. *244,111*. December 4th, 1925; convention date, December 4th, 1924. An edge filter (Hele-Shaw type) is formed of metal laminæ having some parts thicker than others, so that interspaces are formed between the laminæ.—BRIQUETTE BINDING AGENTS FROM BAGASSE, BEET PULP, ETC. *S. W. Carpenter and G. N. White*, of 7, Idol Lane, London, E.C.3. *244,517*. September 16th, 1924. A binding-agent for use particularly in the manufacture of fuel briquettes is prepared by subjecting soft vegetable tissue to aerobic fermentation with retention of the non-gaseous fermentation products, and adding alkali to the material either before, during, or after the treatment. Suitable vegetable materials are straw, water weeds, cactus, prickly pear, rushes, grass, bagasse, beet pulp, sisal, hemp, flax residue, soya bean waste, and leaves or stems of bracken, banana, maize, and potato.—PRODUCTION OF SUGARS (AND OF ALCOHOL) FROM CELLULOSIC SUBSTANCES. *R. Romer*, of The Hague (Assignees of *L. Pink*). *204.475*. September 24th, 1925; convention date, September 25th, 1924. In the production of sugars, such as glucose and pentose, and like substances from wood or other cellulose-containing materials by hydrolysis, an increased yield is obtained by first treating the raw materials so that the lignin, or like substances, are loosened or decomposed, and more of the cellulose is made available for conversion.—HARVESTING BEET. *K. O. Christensen and F. L. Helt*, of Svinninge, Denmark. *244,014*. July 20th, 1925. A beet-lifting attachment for a plough beam consists of a J-shaped arm with forwardly-directed knife edge; the outer part of the J carries an inclined chisel-shaped or knife-shaped cutter which lifts the beets, forcing them over the rear part.

UNITED STATES.

Multiple-Effect Evaporator, with a Secondary Condenser. (*A*) ***Paul A. Bancel*** (assignor to ***Ingersoll-Rand Company***, of New Jersey, U.S.A.). *1,552,534.* September 8th, 1925. (*B*) ***John F. Kirgan*** (assignor to ***Ingersoll-Rand Company***, of New Jersey, U.S.A.). *1,552,562.* September 8th, 1925.

(*A*) Multiple-effect evaporating apparatus can be more economically used with a main condenser and intercooler or intercondenser, and with an evacuator connected to the intercooler, capable of producing a vacuum appreciably higher than the steam pressure in the last or final effect of the series, in order to cause flow of air and non-condensible gases or vapours from the said final effect to the intercooler. By venting the steam box of the last or final effect of the evaporating apparatus to the intercooler, instead of to the main condenser, the primary steam jets and the main condenser itself are relieved of this air and vapour leakage, so that a smaller vacuum pump may be used for evacuation. Referring to the drawings, a plurality of vessels *A* are in series with each other by connecting the steam and vapour outlet pipe *B* of each effect to the steam inlet *C* of the steam box *G* of the next adjacent one. Steam is supplied at the inlet *D* of the first steam box *G*, from any suitable source (not shown), and a main condenser, in this instance a barometric condenser *E* is connected to the outlet pipe *F* from the evaporating chamber of the last effect. Vessels *A* may be of any suitable construction in which the evaporating chamber may be divided by the heating chamber into the usual upper and lower liquid containing chambers connected by circulating tubes which pass through the heating chamber, the syrup being heated in the lower liquid containing compartments or chambers, and the sugar withdrawn from these chambers at the bottom outlets *H*. The main discharge outlets from the steam boxes *G* may be connected in any suitable or usual manner (not shown) to evacuating apparatus. The barometric condenser *E* may be of standard construction. An intercooler, for steam jet condenser pump,[2] is connected to the main condenser by the pipe *K* and primary augmenter jets *L* supplied with steam from the supply pipe *O*, compress air and gases from the main condenser and discharge into the intercooler at low vacuum. The intercooler is supplied with water by the pipe *P* connected to the water supply pipe *Q* of the main condenser. Secondary jets *R* or a vacuum pump *S* or both connected to the intercooler by the pipe *T*, form the second stage of the evacuating apparatus. The water in the intercooler flows over the weir *U* and the pipe or apron *V* protects the vacuum pump connexion from the entrance of water. In accordance with this invention, auxiliary steam box vents *W* from the steam boxes *G* are connected

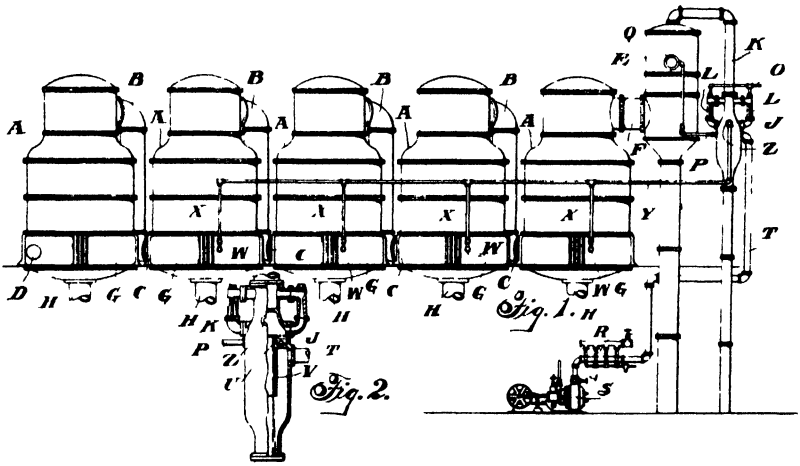


Fig. 1.

Fig. 2.

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[1] See also U.S. Patent, 1,552,563.

[2] Which may be like that disclosed in Patent No. 1,526,040, February 10th, 1925.

to the intercooler *J* for the purpose of venting non-condensible gases, thus relieving the main condenser *E* and primary steam jets *L* of this air leakage. In the present instance, the vents W are located at the lower portions of the evaporators *A*, in the steam boxes *G* forming the heating chambers and the pipes *X* from each auxiliary vent are conveniently connected to the common vent pipe *Y* which is connected to the intercooler at *Z*. Air and other non-condensible gases from the steam boxes pass off through the auxiliary vent pipes *X* and *Y* to the intercooler *J*. The evacuating apparatus comprising the primary jets *L* and the secondary jets *R* and vacuum pump *S* should be capable of producing a vacuum appreciably higher than the vacuum in the last or final evaporator or effect *A* nearest to the main condenser *E* in the series in order to cause flow of the non-condensible gases from the steam box of the said last effect to the intercooler.

(*B*) This specification makes reference to the above one, in which the steam-box of the last effect is vented directly to the inter-condenser. It has, however, been found that in some instances the preferable arrangement is to vent the steam-box of the last effect to a separate and independent two-stage vacuum pump, in which a still lower vacuum may be economically maintained than required for the intercooler, but appreciably higher than the steam pressure in the last effect of the series of effects. Claim is therefore made for a "multiple effect evaporating apparatus, comprising a plurality of steam-heated evaporators connected in series and having steam-boxes, in combination with a main condenser for said series of evaporators having an intercooler connected thereto, main evacuating apparatus connected to said intercooler, a two-stage evacuator separate and independent from both the main condenser and intercooler, and capable of producing a vacuum appreciably higher than the steam pressure in the final effect of the series, and means for venting non-condensible gases from the steam-box of the said last effect into the said independent two-stage evacuating apparatus, thereby causing a flow of air and non-condensible gases or vapours from the steam-box of the said last effect into the said independent evacuating apparatus."

PREPARING AND PRESERVING FIBRES FOR PULP MAKING AND BAGASSE BOARDING MANUFACTURE. (*A*) *E. C. Lathrop and T. B. Munroe* (*a*) *1,572,539* ; (*b*) *1,572,540*. February 9th, 1926. (*B*) *John K. Shaw*, of Minneapolis, Minn., U.S.A. *1,572,565*. February 9th, 1926. (*C*) *T. B. Munroe*. *1,574,254*. February 23rd, 1926.

(*A*) Claim is made for (*a*) the process of preserving and treating bagasse and analogous fibres which consists in subjecting said fibres in masses to suitable fermentations for times sufficient to soften the same and to generate heat on the interior of said masses ; so piling said masses as will retain the heat on their interiors for a time sufficient to lessen the moisture contents thereof and to substantially sterilize said masses ; and preventing sufficient moisture from entering said mass to destroy said sterilization. Also for (*b*) the process of preserving green bagasse and analogous fibres from injurious fermentations during storage which consists in wetting a mass of said fibres to substantially increase its water holding capacity to inhibit the growth of moulds and fungi and to promote the growth of lactic acid producing and similar bacteria ; and keeping said mass sufficiently wet to maintain a fermentation by said last named bacteria until a desired proportion of the parenchymatous matter present is destroyed.

(*B*) Claim is made for the process of producing a substitute for lumber from flexible and strong bagasse fibres which consists in cooking the same while associated with their natural pith in the presence of a suitable chemical and at a temperature and for a time sufficient to loosen the encrusting material of said fibres, but insufficient to produce fibres suitable for paper making ; recovering the fibres thus treated ; and forming said fibres by water deposition into a substitute for lumber.

(*C*) Claim is made for the process of making a heat insulating fibre board which consists in subjecting piled bagasse to an acetic acid fermentation until the fibres present are partially loosened from the bundles in which they naturally occur ; stopping said fermentation before the strength of the fibres is impaired ; mixing with the fermented bagasse a sufficient quantity of fibres derived from wood to aid in drying the formed board; subjecting the mixture thus obtained to a cooking action; refining the cooked mixture of fibres; separating from the refined mixture thus obtained any objectionable constituents derived from the cooking action; adding a fire resisting material to said mixture; and forming the mass thus obtained into a board.

Production, Revivification, and Application of Activated (Decolorizing) Carbon. (*A*) ***Walter C. Cassell and Carl K. Springfield*** (assignors to ***The Texas Carbon Industries,*** Inc., of Tex, Delaware, U.S.A.). *1,573,373.* February 16th, 1926. (*B*) ***Ernest Bateman*** (assignors to the People of the U.S.A.). *1,573 509.* February 16th, 1926. (*C*) ***H. Müller-Clemm,*** of Mannheim-Waldhof, Germany. *1,575,703.* March 9th, 1926.

(*A*) Relates to a process for bolting carbon, including a screening chamber, a fan, means for discharging carbon in front of the fan, and for collecting the carbon which has passed through the screen. (*B*) Claim is made for a process of activating carbon, treating carbon in a comminuted form and while in a free condition with carbon dioxide at temperatures of 650 to 1000°C. (*C*) Claim is made for the process of producing active carbon, which comprises carbonizing carbonaceous material in the presence of an alkali metal sulphide.

Treatment of Kieselguhr to improve its Properties. (*A*) ***Robert Calvert*** (assignor to ***The Celite Company,*** of Los Angeles, Cal., U.S.A.). *1,574,363.* February 23rd, 1926. (*B*) ***Herbert A. Endres*** (Assignor to ***The Celite Company,*** of Los Angeles, Cal., U.S.A.). *1,574,380.* February 23rd, 1926.

(*A*) Claim is made for a finely divided product, comprising the product of heating a mixture of finely divided diatomaceous earth, an hydroxide of an alkaline earth metal, and water. (*B*) Claim is made for the process of producing a finely divided material, comprising heating a mixture of a finely divided silica and lime in water, and then calcining the resulting product.

Utilization of Beet Press Pulp Waters. ***Gaston A. Duret,*** of Paris, France. *1,552,737.* September 8th, 1925. Claim is made for the process for the utilization of the residual waters of the pressing of the beetroot pulp and of the residual waters of the extraction of the juice in the manufacture of sugar, which comprises evaporating said waters to a syrupy consistency at a temperature between 105° and 140°C.”—Production of Sugars and Alcohol from Vegetable Substances. ***Chas. R. Mabee,*** of Buffalo, N.Y., U.S.A. *1,565,282-3.* December 15th, 1925. Methods for the treatment of vegetable materials are described, which comprises subjecting said materials in a moistened condition to an alternate compression and expansion at an elevated temperature and at a pressure, above atmospheric, whereby the starch granules and fibre structures are broken down, rendered more thoroughly assimilable, and a portion thereof converted into sugars. Alcohol Motor Fuel ***Ralph H. McKee,*** of New York. *1,570,161.* January 19th, 1926. Claim is made for a mixed fuel for internal combustion engines comprising a homogeneous mixture of the gasoline-like fraction of shale oil, alcohol and ethylene. Beet Topper. ***Andrew A. Matheson,*** of Shoshoni, Wyo., U.S.A. *1,572,499.* February 9th, 1926. Claim is made for a topping device for beet harvesters, comprising, in combination, a pair of rollers mounted to rotate about substantially parallel, horizontal axes, means for introducing beet tops between said rollers, said means comprising a conveyor belt, a knife, and means for moving said knife up and down in front of said rollers at predetermined intervals.—Beet Puller. ***Oscar A. Thomas,*** of Oxnard, Cal., U.S.A. *1,573,657.* February 16th, 1926. A beet-pulling device is claimed, comprising an annulus adapted to be secured to a vehicle wheel and having a continuous cutting edge, a convex disc arranged in converging relation to the annulus and mounted for rotational movement, and means carried by one of the elements for preventing clogging of earth between the elements.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending March 31st		Three Months ending March 31st.	
	1925.	1926.	1925.	1926.
Unrefined Sugars.	Tons	Tons.	Tons.	Tons.
Poland	172	101	9,016	2,014
Germany	...	856	1,898	856
Netherlands	....	....	....	....
France	....	.	....	...
Czecho-Slovakia	....	...	498	....
Java	....	....	1,861	....
Philippine Islands		....	...	....
Cuba	79,068	9,247	124,906	52,521
Dutch Guiana	....	....	...	....
Hayti and San Domingo	22,865	6,885	35,363	11,588
Mexico	....	....	...	....
Peru	7,605	10,549	36,098	25,910
Brazil	....	....	6,473	95
Mauritius	....	60,597	299	120,321
British India	....	....	....	..
Straits Settlements	....	...	....	....
British West Indies, British Guiana & British Honduras	3,539	4,831	7,262	17,252
Other Countries	8,653	34.789	34,257	122,070
Total Raw Sugars ...	**121,903**	**127,854**	**257,930**	**352,627**
Refined Sugars.				
Poland	2,370	735	13,274	5,282
Germany	157	1,860	5,146	3,320
Netherlands	16,803	30,991	50,620	61,955
Belgium	1,080	299	7,225	1,930
France	....	....	..	....
Czecho-Slovakia	22,104	22,263	81,121	65,036
Java	....	....	....	....
United States of America	4,596	1,193	5.391	1,847
Canada	7,684	5,345	9,972	14,204
Other Countries	52	248	273	8,106
Total Refined Sugars .	**54,847**	**62,935**	**173,022**	**161,681**
Molasses	5,374	18,845	27,526	52,801
Total Imports	**182.124**	**209,634**	**458,478**	**567,109**

EXPORTS.

British Refined Sugars.	Tons.	Tons	Tons	Tons.
Denmark	169	89	215	243
Netherlands	17	54	58	115
Irish Free State	3,048	4,330	10,036	14,713
Channel Islands	73	56	190	175
Canada	....		....	...
Other Countries	352	5,398	1,229	14,726
	3,659	9,927	11,728	29,973
Foreign & Colonial Sugars				
Refined and Candy	111	146	442	456
Unrefined	54	536	140	598
Various Mixed in Bond	....	....	....	....
Molasses	77	640	139	1,025
Total Exports	**3,901**	**11,249**	**12,449**	**32,052**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1926. Tons.	1925. Tons.
Total Receipts, January 1st to March 31st	908,053	924,102
Deliveries ,, ,,	831,558	913,517
Meltings by Refiners ,, ,,	782,000	820,430
Exports of Refined ,, ,,	23,000	37,660
Importers' Stocks, March 31st	85,151	10,585
Total Stocks, March 31st	207,987	127,529
	1925.	1924.
Total Consumption for twelve months	5,510,060	4,854,479

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924 Tons.	1925 Tons	1926 Tons.
Exports	883,915	940,585	817,666
Stocks	437,958	623,658	684,263
	1,321,873	1,564,243	1,501,929
Local Consumption	17,000	23,000	23,000
Receipts at Ports to February 28th	1,338,873	1,587,243	1,524,929

Havana, February 28th, 1926 J. GUMA.--L. MEJER

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR THREE MONTHS ENDING MARCH 31ST, 1924, 1925, AND 1926.

Imports.	1924. Tons.	1925. Tons	1926 Tons.
Refined	111,456	173,022	161,681
Raw	316,029	257,930	352,627
Molasses	39,394	27,526	52,801
	466,879	458,478	567,109

Exports (Foreign).	1924. Tons	1925 Tons.	1926. Tons.
Refined	356	442	456
Raw	4,750	140	598
Molasses	405	139	1,025
	5,511	721	2,079

Home Consumption.	1924. Tons.	1925 Tons.	1926. Tons
Refined	84,862	184,701	114,467
Refined (in Bond) in the United Kingdom	217,752	170,153	210,423
Raw	19,652	23,024	40,666
Total of Sugar	322,266	377,878	365 556
Molasses	2,406	1,431	1,700
Molasses, manufactured (in Bond) in United Kingdom	15,216	15,268	16,490
	339,888	394,577	383,746

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT MARCH 31ST, 1926.

	1924. Tons	1925. Tons.	1926. Tons.
Refined in Bond	56,800	37,500	67,550
Foreign Refined	48,000	22,550	167,800
,, Unrefined	149,150	125,700	246,200
	253,950	185,750	481,550

United Kingdom Monthly Sugar Report.

Our last report was dated the 10th March, 1926.

The market has been quiet but steady during the period under review and there has been an entire absence of violent fluctuations.

The London Terminal Market is still suffering from the accumulated stocks in London but a large amount of business has been put through. About 40,000 tons were tendered on March and this account was finally liquidated at 13s. 5¼d. There were few dealings in April and only about 1000 tons were tendered. On the other hand May is now in the process of liquidation and has fallen to a discount of 9¾d. under August. May was dealt in from 13s. 9d. down to 13s. 3d. to 13s. 10½d. to 13s. 6d. A fair amount of this May has been transferred to August and the remainder to either December or March. A large business has been done in August from 14s. 6d. down to 13s. 10½d. to 14s. 8¼d. to 14s. 4½d. A considerable interest is being shown in new crop, and December sold from 14s. 9d. down to 14s. 1½d. to 14s. 10½d. to 14s. 6d. March, 1927 sold from 14s. 11¼d. down to 14s. 6¾d. to 15s. 1½d. to 14s. 10½d. The latest prices are May 13s. 6d., August 14s. 3¾d., December 14s. 7½d., March 14s. 10½d.

Trading in actual sugars has been slightly better. The dealers, who had adopted a very pessimistic attitude, have been holding very little sugar and any slight advance has brought them in and they have bought readily for immediate requirements. Owing to the frost on the Continent and the bad weather in London a small proportion of the London stock has gone out of condition and makes it more difficult of sale. Europe have not pressed their sugar although stocks in exporting countries seem to be large. Ready Granulated sold from 14s. to 13s. 7½d. to 14s. 4½d, to 14s., and April/May shipment sold from 14s. to 14s. 3d., whilst April/August sold from 14s. 9d. to 14s. 6d. November/December Granulated sold at 14s. 6d. to 14s. 9d. American Granulated has not been pressing but could have been bought for 14s. 9d. down to 14s. 6d. The latest price is 14s. 10½d. c.i.f. India has not been in the market as a buyer and no further purchases are reported.

Spot sugars in London have been sold from 26s. 9d. down to 26s. 6d. up to 27s. 1½d. Mauritius sold on the spot at 25s. to 25s. 6d. according to quality.

The Home Grown factories have now practically finished this year's crop and in marketing the balance they at one time put the price at 26s. 9d. Remnants are now able to be bought from 27s. 3d. to 27s. 6d.

The British Refiners have done a fair business. On March 23rd they reduced their prices 3d. per cwt., but on March 29th they were raised again by 3d. On April 1st they made a further advance of 3d. per cwt. and on April 12th Granulated was advanced by 3d. per cwt. and Cubes by 6d. per cwt. The latest prices are No. 1 Cubes 32s., London Granulated 28s. 7½d.

Owing to the large stocks in this country only a small business has been done in raws to the British Refiners. Business was done in Cubans at 11s. down to 10s. 6d. and up again to 11s. San Domingo cargoes also sold at 10s. 9d. Several cargoes of Cubans were also sold to the Continent during the month.

In New York a fairly large business has been done in raws to the American Refiners, but the Cuban has always been an anxious seller. The price fell from 2¼ to 2⅛ cents c.i.f. N.Y, but the latest price is 2⁵⁄₁₆. The Futures Market has had many fluctuations but is now at practically the same level as a month ago.

The receipts to date at the ports in Cuba now amount to 2,696,051 tons against 2,782,889 tons last year, but the stocks at the ports are 1,233,866 against 916,965 tons last year. Owing to the unremunerative prices, the growers are agitating to the Cuban Government to take steps to artificially curtail this year's crop by 5 per cent., or even 10 per cent., in order to stimulate the price to a higher level. Negotiations are going on this week, the result of which has so far not been published.

With regard to the European crop, there have been no signs of Germany exporting any sugar up to the present. F. O. Licht has given the estimated sowings for the next European crop and there are decreases in Germany, Czecho-Slovakia, Holland, Belgium and Poland, whilst France, Italy and Russia show increases. The total for the whole of the European crop, including Russia, is 2,165,000 hectares, against 2,131,556 hectares last year.

21, Mincing Lane,
London, E.C. 3.
April 14th, 1926.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE
INTERNATIONAL SUGAR JOURNAL.

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No. 329. MAY, 1926. VOL. XXVIII.

Notes and Comments.

An Abortive Strike against the Nation.

This issue is a few days late on account of a serious but abortive attempt on the part of the leaders of the trade unions in this country to paralyse all trade and industry by calling all their unions to strike in supposed aid of the coal miners. While negotiations were in progress between the Government and the miners to try and get the latter to agree to do their part in carrying out the recommendations of the Coal Commission's report, the Trades Union Council (a body that professes to watch over the interests of all the various trade unions and which had recently abrogated to itself the right to call out the members without any previous reference by ballot) suddenly decided to try and force the hand of the Government in aid of the miners by means of a lightning strike, on a scale never before attempted. Within 48 hours of their announcing their intention, they forced the strike on an unsuspecting country, calling out all the railway and other transport workers, and what was worse, all the workers in the newspaper and other printing establishments, so that for a day or two folk could not generally get to work nor could they get any printed news. Later on, they tried to prevent the movement of food supplies from the dock warehouses.

This was no ordinary trade dispute, but a challenge to the Government and through the Government to the nation. The Government accepted the challenge, enrolled thousands of volunteers, either as special police to preserve order or as transport workers to ensure the distribution of food ; modern resources in the shape of motor cars and wireless communications got the people about and told them the news, so it was not surprising that within a few days the Government got the upper hand; they published a special newspaper distributed all over the country by motor or aeroplane; the press after the first shock succeeded in issuing papers of some dimensions or other ; all attempts to stop traffic in the streets and on the railways were speedily thwarted by the volunteer police, while food was dramatically convoyed from the docks with the aid of troops and armoured cars. The attitude of the strikers was more one of obedience to their Unions than of harbouring any grievance in their own case, so resistance save in disaffected areas was at a minimum, and after nine days the labour leaders decided it would be better to accept defeat and call off the strike unconditionally.

Thus ended the biggest struggle between a section of the community and the constitutional Government that has ever been experienced in this country since the last civil war took place. There was never much doubt in the mind of the public as to the outcome of it ; the danger was fortunately seen months ago when the Government staved off trouble last August by giving a subsidy to the mining industry pending an investigation by an impartial commission; there is little doubt that had they not done so then, a similar lightning strike would have been precipitated and would have caught the country unprepared. The interval has enabled those concerned to prepare for another possible bout of trouble on the expiry of the subsidy, and the result now is more satisfactory to the nation. It only remains to apply the lesson justly and impartially, so as to make it impossible for any large body of workers to hold the country to ransom in an attempt to establish one given trade on what may be entirely uneconomic conditions.

The Cuban Crisis.

The unsatisfactory state of affairs existing in the sugar industry in Cuba the last few months, owing to the uneconomic prices that have prevailed, has come to a head more quickly than some observers anticipated. As an article we quoted from in our issue of last March[1] pointed out, Cuba has latterly been producing sugar at a price which only allowed the most favourably situated factories to make a profit, while the *colonos* being paid on a basis governed by the price of sugar were now in receipt of totally inadequate remuneration for their supplies of cane. On the other hand, as we showed last month, there is still an active movement amongst some of the more powerful Cuban-American companies in Cuba to extend yet further their plantings, and to aim at a crop that would run into six million tons.

Fortunately for the Cuban industry as a whole, those in authority have given a ready ear to the representations made by so many of the sugar producers that it would be ruinous to go on increasing the sugar production in advance of the ability to find a market to take it. Early in April the weakness of the sugar market was such that a panic set in and a run was made on the banks (doubtless in the belief that these had lent more money to the sugar interests than the sugar accruing was worth); but prompt action by the President (who set an example of faith in the stability of the banks) and the ability to procure supplies of money from the United States easened the position. But it left a situation that called for early remedy, and the Cuban President, who is proving himself a strong man, has with his Cabinet initiated legislation of an important character.

They have accepted a plan put forward by the sugar interests to reduce the Cuban sugar crop by 10 per cent. or roughly by half a million tons, which amount is considered to be the excess that depresses the market. This reduces the output to a figure in the neighbourhood of 4,700,000 long tons. The Bill, which according to cable advices has been approved by both Houses of the Cuban Congress, gives the President power to fix the date of commencing grinding operations, and provides for a fine of 2000 dollars a day on any mills starting before that date. A tax of $5 per bag is also to be levied on all sugar produced in excess of 90 per cent. of the estimated crop of each mill during the present year. Apart from that, the President has already signed a decree prohibiting any further clearing of forest lands before January 1st, 1927 ; this will prevent any new planting of cane till after that date, and as a result the 1927 and 1928 productions will be affected. This means that the enforced reduction is to be made applicable to the next two crops.

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When the news of this scheme first reached the American sugar market, many observers were inclined to doubt whether it would work in practice, deeming that it would be difficult to get all the sugar interests in Cuba to agree to the restriction. But it soon became evident that the Cuban Government was in earnest, and as more than 60 per cent. of the producing interests had signed an agreement by the middle of April, it was clear that the rest would soon have to fall into line. One consideration that has probably weighed is that this 10 per cent. reduction equals roughly the amount of unremunerative cane lands that are still being worked. Of course a 10 per cent. allround reduction can hardly be expected to eliminate all the unprofitable fields, nor those only; but it will, as we show below, go a long way to cut out a source of economic weakness, since if these lands are not a paying proposition their more or less complete elimination will tend to increase profits rather than to reduce them, and in that respect will relieve the situation. The argument in short is: Cuba is now selling at a loss; it is hence better to produce 10 per cent. less if by so doing the rest of the sugar can be sold at a profit. One hears the argument advanced that any self-denial on the part of Cuba will only result in other cane-growing countries increasing their output; but canefields as is known take 12 to 18 or more months to mature, while the beetfields are probably fully committed to a given output for the next crop, whatever increase in sowings they may attempt in the spring of 1927. Moreover, there is a parallel in the rubber planting industry, where the fact that the Stevenson restriction scheme applied only to British plantations and left the Dutch ones free to increase their output, if they deemed fit, had no effect in retarding a result that has proved of inestimable benefit to all the rubber growers, British and Dutch alike.

Production outrunning Consumption.

The plain fact of the matter is that production has now for some little while past greatly outrun consumption, and the example set by Cuba should go a long way to rectify the disparity. It was thought in American circles that demand would catch up with the present supply during the present year and so lead to a gradual improvement in prices. But in America at any rate consumption is not continuing to increase at a rate sufficient to absorb the supplies that will be available this season, so it was time to call a halt in production if the industry was not to be ruined by uneconomic factors.

The situation on the home market in April was one of excessive stocks and low prices. A Mincing Lane correspondent of the *Manchester Guardian* recently summed up the situation with regard to stocks at home and abroad as follows:—"One authority gives visible supplies in this country, the United States, Cuba, and the principal Continental ports at 4,411,000 tons, in comparison with 3,370,000 tons a year ago, and with 2,860,000 tons at the corresponding date in 1924. In Cuba alone stocks now aggregate 1,150,000 tons, against 802,936 tons a year ago and 660,388 tons in 1924. Stocks of raw sugar in this country are computed at 211,000 tons, as compared with 57,000 tons at this time last year and with 84,000 tons in 1924. Our refiners are now dealing mainly with stocks of "preferential" sugar from Mauritius and Australia, and Cuban sellers express disappointment that British inquiries for their produce are not so numerous and pressing as usual. The London market is overloaded with foreign refined sugar, the total of which is 106,248 tons; to this figure has to be added the stock of home-refined, which brings the aggregate up to 160,000 tons in round figures. Much of this sugar has been in stock since December, and possibly the condition of it will make sales rather difficult. The total stocks of refined sugar are nearly seven times the figure at this time last year."

The Real Position in Cuba.

The causes that have brought Cuba to her present pass are not far to seek. They are in our view pretty accurately summed up in an article in a recent issue of *Facts about Sugar*, entitled "Killing the Goose in Cuba." This, from the pen of one who is described as a prominent sugar man, an officer and director of Cuban sugar companies, expresses a view, with which most observers of Cuban sugar economics will not be inclined to cavil, though perhaps not agreeing fully with every statement. This writer maintains, in the first place, that the expansion of Cuba's crop has outrun the development of available markets. She has increased her output within ten years from about two and a half million tons to over five millions, or an increase of fully 100 per cent., oblivious of the fact that the United States, her principal customer, has only increased its consumption by about 50 per cent. in that time. In round figures this consumption about ten years ago was about one million tons in excess of the Cuban crop, whereas in 1925 it was considerably less than half a million tons in excess, while the American domestic and insular crop produced nearly three million tons (as compared with two million ten years ago) to add to the amount available for U.S. consumption. No wonder, then, a surfeit of sugar has resulted. The increase in Cuban production has been particularly marked the last three years, and according to the writer of the article it has been mainly due to the craze for expansion that has taken possession of some of the large Cuban-American companies, carried out without regard to the question whether a market existed for the additional output.

Next, he maintains that as a consequence of over-production it follows that the more sugar Cuba makes the less she receives for her total crop; according to figures quoted from Willett & Gray's Journal there has been a steady decline in profits since 1923. In that year (again in round figures) a production of some 3½ millions averaged 5·24 cents per lb. in price, and was valued at 423 million dollars; in 1925 a five million ton crop realized less than half the above price (namely, 2·5 cents) and was valued at only 294 million dollars; while the 1926 crop, estimated at 5,300,000 tons, will average even less, and probably fetch no more than 255 millions. The conclusion drawn from these figures is that a smaller crop would pay better in the present state of world consumption. Cuba can count with some certainty on finding a market at reasonable prices for four to four and a half million tons. It is the last half-million that is claimed to be breaking the Cuban camel's back.

Although this article we are quoting was written before the decision of the Cuban Government was published, the writer was evidently aware that representations had been made to Government quarters to solve the problem by reducing the crop by legislation to 90 per cent. of the 1925 output. He, however, urges the point strongly as the only feasible solution of the problem. He thinks Cubans have been living in a fool's paradise if they seriously thought the U.S. tariff was going to be reduced in their favour; what is more, he quotes figures which tend to prove that the existing tariff preference has not been obtained by the Cuban producers. On the contrary, owing largely to Cuba having to compete even against herself, she has to sell her sugar to the United States at the same price as other countries do and frequently at a slightly lower price—all because she continues her futile effort to produce more and more sugar, albeit at a loss.

What Cuba wants, in the opinion of this writer, is to drop temporarily all thought of extending cane acreage; to eliminate all lands that are producing less than 15 tons of cane per acre (that alone would reduce the crop by 10 per cent.) and that are cultivated at a loss even under good prices; to adopt a system of agricultural improvement such as will increase the yields of lands worth keeping in cane; to put the *colono* system on a sounder basis; to eliminate "graft" by removing the grafters; and to introduce economies that are badly needed in cane cultivation, cane handling, and sugar manufacture. By the time Cuba has set her house in order, the way may be open for further expansion in output.

Incidentally, the same writer shows how the present position is depreciating the value of sugar properties in Cuba. We are told, he says, that the cost of fitting up a plantation for sugar production in Cuba to-day is about $35 per bag of capacity, which means that the producer must receive roundly a cent a lb. profit to pay interest on his investment. Not even 3-cent. sugar would achieve this return, and it appears inevitable that properties capitalized on this basis are doomed to disaster. Even if sugar fetches 3 cents it justifies a capitalization of less than half the amount required to develop new properties, since at $15 per bag at least half a cent per lb. of profit is required.

The Budget of 1926.

Mr. CHURCHILL'S second Budget introduced nothing of a radical nature in the incidence of sugar taxation. The duties were continued as before. The Chancellor stated that home-grown sugar had cost the Exchequer £2,750,000 in subsidy and a loss of revenue of over half a million more; but it is expected to produce this coming season over 130,000 tons of sugar. Then the result of the Government's action last year in restoring the Imperial preference on sugar entering this country stimulated the imports. In 1923 these amounted to 368,000 tons, but in 1924 under the reduced stimulus of the Labour Government's small preference the imports fell to 165,000 tons. Last year with the preference stabilized at a halfpenny per lb. they rose again to practically the 1923 level, and in the opinion of the Chancellor we may look forward to a further increase in the present year. Incidentally, the stabilizing of the preference on sugar for ten years has been now repeated in respect to all other Empire products that are in receipt of a preferential entry into this country. The Government cannot of course commit their successors; but Governments do not as a rule reverse the edicts of their predecessors without some strong political motive. And the Labour Party (the only alternative government in this country) do not lack for men who take a broad view of Imperial responsibilities. An Empire Parliamentary Delegation which visited the West Indies last winter had ample evidence placed before them that the sugar industry out there is passing through a period of extreme depression, in spite of the fact that the proprietors have as a rule done everything they possibly could to make the industry efficient by means of central factories, labour-saving machinery and scientific research. The plea is strongly urged that the Preference should be increased, by taking off the rest of the import duty. But it is the low price sugar is fetching at present that gives the last turn to the screw.

Death of Mr. James Fairrie, of Liverpool.

We regret to record the death on April 7th of Mr. JAMES FAIRRIE, head of the well-known Liverpool refining firm, Messrs. Fairrie & Co., Ltd., who passed away in his sixty-fourth year. He was a man of particularly retiring disposition, but was held in high esteem by all his employees for his kindly human qualities; he inherited an old tradition not only of good works and philanthropy, but also of industry and acumen; and his loss will be felt in Liverpool circles. At the time of his death he was president of the British Sugar Refiners' Association, chairman of the Lancashire Sugar Refiners' Association, and chairman of the Sugar Association of Lancashire.

The FAIRRIES were originally in business in Scotland. The first JAMES FAIRRIE, of whom there is record, was a shipmaster at Irvine, and was born in 1688. His son JAMES, born 1730, was a West India merchant and shipowner. The third JAMES in succession was born in 1754, and he it was who founded the refining business under the title of JAMES FAIRRIE & COMPANY, sugar refiners, Greenock. He died in 1815, in which year his three sons, JOHN, JAMES and ADAM, were 25, 20 and 17 respectively. They not only carried on the Greenock business, but also subsequently established refineries in London and Liverpool. ADAM was responsible for the Liverpool venture, and his son JAMES was the father of the JAMES FAIRRIE who has just died. The Greenock house was wound up on the death of THOMAS FAIRRIE in 1858, and the London one in 1865, shortly after the death of JOHN FAIRRIE in 1864.

The Liverpool firm, previously named FAIRRIE BROTHERS & COMPANY, changed its title in 1866 to FAIRRIE & COMPANY, LTD. The surviving members of the FAIRRIE family are LESLIE and GEOFFREY FAIRRIE, sons of the late JAMES FAIRRIE, and on them will devolve the task of carrying on the FAIRRIE tradition and conducting the business to which their father devoted the whole of his working life of forty-five years. It is to be hoped that they will meet with full success in their venture.

British Empire Sugar : Need for Organization.

The *Times* lately celebrated the tenth anniversary of its weekly Trade and Engineering Supplement by issuing a special number devoted to British Empire Products. The article devoted to Cane Sugar, which surveyed the output in sugar of the British Empire, contained a plea for a better system of organization so as to develop a comprehensive Empire sugar policy.

The sugar producers of the Empire are now already to some extent organized; but they propose to form themselves into a Sugar Federation, with the object of co-ordinating the interests of all Empire sugar-producing and using industries. It is hoped that all sugar interests, including the great using industries in Great Britain will eventually co-operate with the work of the proposed Federation. At the same time it is useless in our view to ignore the difficulties that present themselves as regards the conflicting interests of the refiners at home and the gradually extending manufacture overseas of direct consumption sugar. Whether the two can be reconciled sufficiently to enable them all to join the Federation remains to be seen. What is clear is that the march of scientific progress will render inevitable the extension in the future of the practice of making white sugar in one process at the milling factory, whatever the refining interests may have to say.

The *Times* survey of the sugar situation, we may add in conclusion, deems that sugar is not nearly far enough advanced in the Empire, but the preference as soon as prices recover should encourage increased production. Mauritius and the West Indian Islands cannot be expected to add very largely to their quota, but British Guiana and the whole of the East African regions are capable of very great development and should receive close attention from all interested in this industry.

A New Bid for Steam Turbine Supremacy.

Twenty-five years ago the first steam turbine passenger ship in the world was put into use on the lower reaches of the Clyde, and was the precursor of a revolution in ship propulsion. The same shipping company has this year launched another experimental vessel which is destined to challenge the growing competition of the internal combustion engine for marine or other purposes. The steam turbine on land is rapidly replacing the reciprocating engine, and those interested in turbine propulsion deem the time ripe to attempt to re-establish the superiority of steam produced by means of boiler fuel such as coal over the internal use of oil as employed by the Diesel type of engine. The new scheme is to employ higher steam pressure, superheating, and air-preheating. In the case of this new steamer, water-tube boilers designed for a pressure of 550 lbs. per sq. in. are to be employed, the steam temperature being 750° F. The condensers will work at a high vacuum and the temperature of the feed water will be about 300° F. It may be added that Sir CHARLES PARSONS, the inventor of the steam turbine, is backing this latest experiment, as he did the earlier one 25 years ago.

The Sugar Industry in Canada, 1924.

According to the Dominion Bureau of Statistics, the number of factories in Canada during 1924 reporting sugar operations was seven, of which two were in Ontario, two in Quebec, one in New Brunswick, one in Nova Scotia, and one in British Columbia. The quantity of sugar manufactured in Canada, either from imported cane raws or from Canadian beets was 435,814 short tons; the refined sugar imported amounted to 21,463 tons, while the exports came to 42,015 tons. This left the net amount going into consumption in Canada 415,262 tons. The refined sugar production of Canada for the year in question amounted to 348,378 short tons of granulated cane, and 42,885 tons of granulated beet. The sugar beet production for sugar manufacturing purposes was the yield of 31,111 acres of beets, amounting to 295,177 short tons of roots, or 9·49 tons to the acre. In 1925 the production is estimated to have amounted to 458,200 tons, grown on 43,418 acres, the yield per acre being 10·55 tons. But these 1925 figures are estimated from returns collected from the farmers in June and include roots that are fed to live stock; whereas the 1924 statistics above recorded relate only to beetroot grown under contract for the production of beet sugar and are based on the figures furnished by the beet sugar factories.

As a result of negotiations that have been under way for some time it is confidently expected that a sugar manufacturing plant will be erected this year at Winnipeg. Successful tests of growing sugar beet in 166 places in Manitoba are on record, while the calculated tonnage per acre is put at 13·48.

Owing to the uncertainties engendered through the printers' participation in the national strike, this issue is slightly curtailed, and the usual Market Report has had to be omitted.

In February the new factory of the Jamaica Sugar Estates, Ltd., at St. Thomas, Jamaica, started operations. This is claimed to be the largest factory ever erected in that island. The machinery and equipment, supplied by Messrs. Duncan Stewart & Co, Ltd. of Glasgow, is capable of dealing with 10,000 tons of sugar per crop, but provision has been made to double this output when occasion arises. The present mills are capable of crushing 1000 tons of cane per day. They consist of a double crusher and three 3-roller mills, and are driven by the only steam unit in the factory, all other machinery in the factory being electrically driven. The electric generators are driven by high-speed, totally-enclosed, vertical engines, which along with the mill engines will receive their steam from three large Babcock & Wilcox boilers fitted with bagasse feeders, as well as with oil fuel burners for starting up or in case the bagasse supply is not sufficient for requirements. The factory has also a petrol-driven engine for week-end or off-season work.

Modern Steam Generation.

III.

By JOHN D. TROUP, M.I.Mech.E.

(Continued from page 191).

BOILER HOUSE CONTROL.

Boiler house control has taken a new meaning in recent years, although the conditions for economic steam generation remain the same to-day as at any time in history, and further, those conditions apply equally to all types of boilers and regardless of their size. It is important to bear these facts in mind, because the term scientific control in the boiler house is apt to give the impression that such control is only for the super-plant, whereas the principles apply equally to the small single unit, but the details must of course be modified to suit the different conditions.

Modern scientific control in the boiler house may be conveniently divided into two main sections, namely (1) Combustion control, and (2) Maintenance of clean heating surfaces. The latter concerns the treatment of feed water regarding the internal boiler heating surface, and the regular removal of soot and flue dust as regards the external heating surface. We propose however to leave this section for a future article and deal here with the combustion problems. Provided the boiler heating surface is maintained in a clean state, it only remains to operate the furnace efficiently in order to maintain the boiler plant at maximum efficiency.

The trend of development is towards automatic control, and the use of powdered fuel in large boiler units has given a special impetus to this development. There are a number of different systems of automatic control in operation in America, but so far the practice has not been adopted in this country. It is therefore instructive if we briefly consider what this movement means.

Automatic combustion control is a problem which offers fascinating possibilities from a theoretical point of view, but from the practical point of view there are some obvious difficulties. Many of our modern power stations may be said to be operating under semi-automatic control, in that they are equipped with instruments which record the conditions at each economic point in the boiler house, when the human element is then only called upon to regulate in accordance with the readings of the control instruments. But automatic control goes further than this, and causes the regulation to be carried out automatically by mechanical means.

Our friends across the Atlantic appear to have gone into this matter rather thoroughly, and quite apart from its adaption in connexion with pulverized fuel, it is operating in a number of industrial plants on different types of solid fuel stokers, and apparently with every success. Automatic control with pulverized fuel is a relatively simple matter, and is an obvious step in the development of this system of boiler firing, but the problem of control with solid fuel is a very different matter.

In practice it may be said that no boiler plant operates at a constant load, variations in demand for steam take place over short or long periods of time in accordance with the requirements of an individual factory. To meet these variations and at the same time maintain the highest efficiency in the boiler house, it is necessary that the fuel supply to the furnace and also the air supply for combustion should each be regulated to correspond with the variations in the steam demand from the boiler. When these regulations are dependent upon the personal control of the boiler attendant it is not possible in the average boiler house to make the necessary adjustments with any degree of accuracy. If we consider the heat storage effect of the average stoker it will be evident that this factor alone will create a time-lag which makes any great accuracy impossible with human control alone. Hand control must necessarily be intermittent in its results even when performed by skilled attendants, and of course the claims for automatic control are much stronger in the case of unskilled and semi-skilled attendants.

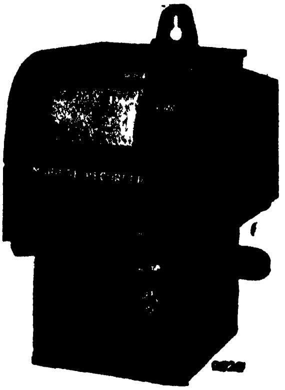
It is because of the practical difficulties in efficiently controlling combustion to follow a variable steam demand that automatic combustion control is being adopted, and it will be instructive to consider briefly the principles involved and some of the methods already in use in America.

Reduced to its elements the problem is very simple. What has to be done is to regulate the air supply in proportion to the fuel supply, and to regulate the fuel supply in proportion to the steam output from the boiler. For a given set of conditions these regulations when operated automatically give us ideal combustion conditions in the boiler house. The set of conditions referred to includes fuel, type of stoker and furnace. These items largely determine the ratio between air and fuel, and of course any change in the nature or quality of fuel calls for a readjustment of this ratio.

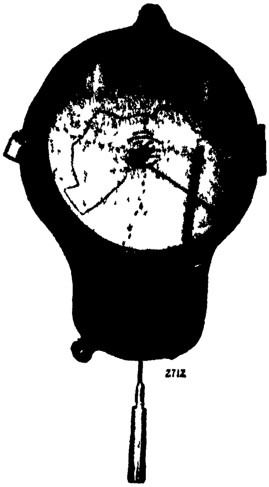
It must be kept in mind that we are only considering automatic combustion control, which means that our principle concern is simply the rate of fuel and air supply, as these are the two materials which must be controlled in order to maintain the highest combustion efficiency. Automatic combustion control therefore centres round these two items, and the design of the different apparatus now in use is such that they take control of the rate of fuel and air supply to the furnace. The principle upon which this control is carried out in practice is based on the steam demand from the boiler. When there is no steam demand, and assuming that the boiler fires are banked up, then theoretically the pressure in the steam main is constant. When, however, the boiler is put into service and a demand is made for steam, there is immediately a difference in pressure created in the steam main, and it is this pressure difference which is utilized as the master control of the different automatic apparatus for combustion control.

Taking now the general equipment for one design of automatic apparatus which appears to be giving every satisfaction in practice, we find that the master control is operated by utilizing the principle of the mercury barometer, when the U-type pattern is adopted. Steam from the main supply pipe is admitted to one leg of the mercury U tube, and by means of a float in the other leg the necessary movement is made available to operate the different control units. The principal claim made for this method is that it is positive in its action, and that the float has a relatively very large movement. In the early designs of automatic control apparatus a diaphragm was used to create the necessary movement due to differences in steam pressure, but such movement was so very slight that it was not effective in actual practice.

Once this master control is established, it becomes a relatively simple matter to couple it up to control the rate of fuel and air supply in relationship to the steam standard. In one standard design the movement of the float in the mercury U tube is caused to operate a tiny slide valve which controls the water supply to a hydraulic cylinder, the piston of which is double-acting, and the design is such that the piston may be held stationary in any position within the limits of its travel. This hydraulic cylinder gives the necessary power to operate both air and fuel supply by mechanical means. To take a simple example for illustration, we will assume natural draught, and the stoker operated by means of a small steam engine, a practice which appears to be somewhat common in the States. In such a case as this the motion from the hydraulic control piston is carried by means of rods and levers to the damper for air control, and in a similar manner to a specially-designed steam valve on the stoker engine for fuel control.



CAMBRIDGE THREAD RECORDER FOR TEMPERATURES.



CAMBRIDGE THERMOGRAPH FOR RECORDING TEMPERATURES.

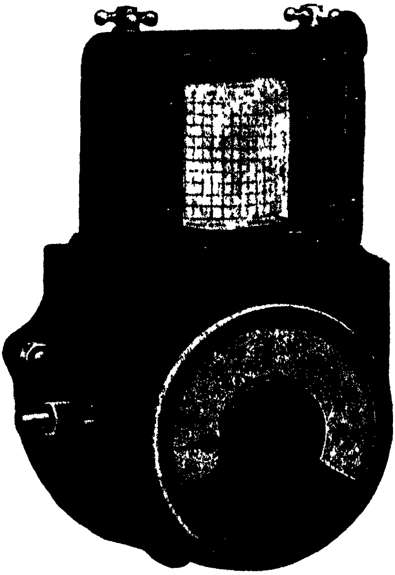
By this arrangement it follows that any variation of pressure in the main steam supply immediately operates the hydraulic piston which in turn operates the draught damper and speed of the stoker in a predetermined relationship.

There are of course many different arrangements of this principle, and the master control may be arranged to operate an electric motor on the stoker and a similar arrangement is adopted in the case of mechanical draught.

The air and fuel controls above referred to do not, however, completely meet the requirements for efficient control of combustion. It will be noted that once the relationship between rate of air and fuel supply is fixed in any individual plant, such relationship is constant until any alteration in the adjustment of the plant is made. The relationship of air and fuel is determined for an individual plant after the nature and heat value of the fuel is known, and provided that the nature and composition of such fuel and fuel bed does not vary, then the automatic control of fuel and air as above described would be satisfactory. In practice, however, allowances must be made for variable conditions in the boiler furnaces. We will consider a rather extreme case in order to make this point clear. Assume that a chain grate stoker is in use, and that the adjustments are made to fix a certain relationship between rate of stoker feed and air supply when the average size of the coal is, say, ½ in. cubes. Such fuel bed will give a definite air resistance, which has been a factor in determining the fuel-air relationship above referred to. Now if for some reason a patch of coal came through with cubes of an average size of, say, 1 in. cubes, or there was a patch of coal which burned more freely than the average, then it is clear that the air resistance would be reduced, due to a freer air space through the grate, and consequently a larger volume of air would pass which would of course upset the carefully pre-determined relationship and adjustment of fuel-air supply.

To overcome this difficulty a furnace regulator is used as a unit in the automatic combustion control equipment. The principle of this apparatus is based on the action of the ordinary gasometer, and the pressure or vacuum variation above the fire bed is used to give motion to the gasometer bell, which motion is used to operate a power generator such as the hydraulic cylinder already referred to, and the motion is carried on to the damper in the air inlet to the furnace. It will be understood that this furnace air regulator operates as auxiliary to the master regulator, this latter keeping a definite relationship between air and fuel supply rates, and of course there are many different combinations for the different systems of draught in use.

From the above brief outline it will be seen that automatic combustion control carries out continuously and immediately any changes in fuel and air adjustment as are required due to the variations in demand for steam. Such regulation is now carried out by the boiler attendant, who is only able to make such adjustments intermittently and after a certain period of time has elapsed after the steam demand has been made.



Bailey Steam Pressure Indicator and Recorder.

An auxiliary of more than passing interest which is adopted as standard practice in connexion with automatic control apparatus is what is termed the *Combustion Indicator.* This is nothing more than a very large dial with a rotating pointer operated mechanically from the master combustion control. This means that the slightest variation in steam pressure is immediately recorded on this dial. In one design the pointer moves 8 in. for every 1 lb. variation in the steam pressure, showing the ease with which the boiler attendant is able to watch the performance of his boiler. When used in connexion with automatic control it is also an indication of the rate of fuel and air supply, as both these rates are controlled from the master control; in other words, such an indicator is a complete visual record of the state of combustion at any particular moment, which tells the attendant what each unit of the control apparatus should be doing. This application of a combustion indicator is a good lesson on the valve of steam flow meters which we are only beginning to appreciate. The master control which we have been considering is merely a mechanism for responding to the difference in rate of steam flow which is recorded on the indicator, and this is what our standard steam flow meters do. It will be clear, therefore, that a steam flow meter gives us visual indication of what adjustments are necessary in order to adapt fuel and air supply rates to varying steam demand.

From the above remarks it will be clear that combustion control means the maintaining at all loads of the correct relationship between fuel and air supply. Whether the control is automatic or not, it is necessary to have a proper equipment of instruments in order that the boiler house engineer may know that maximum furnace efficiency is actually being maintained. For this reason it is essential to know the chemical composition of the flue gases, and the temperatures of these gases at a number of points in their travel through the boiler passes, particularly the exit temperature. With these two records we know whether the maximum heat is being liberated in the furnace and also if this heat is being absorbed by the boiler heating surface. For ordinary hand control it is essential to know the air or draught pressure at suitable points, as this factor is the guiding means of control for keeping the combustion conditions at their maximum efficiency. Feed water and steam temperatures should also be taken, and every boiler should be fitted with a large dia. steam flow meter.

This brief outline represents the principal equipment of a modern boiler house for economic control; but in addition it is essential that a continuous record be kept of fuel consumed and steam generated, as these figures are the final test of overall efficiency.

A first export of English beet pulp from this country, amounting to 500 tons, was recently shipped from London to Alabama, U.S.A., being destined for live stock feed.

According to cable advices from Java the 1926 sugar crop there is estimated at 28,900,000 piculs (2,005,500 long tons) as against 33,600,000 piculs (2,278,900 tons) for 1925.

The final figures for last season's sugar crop in South Africa, according to the Standard Bank *Monthly Review*, show that the quantity of sugar manufactured was 239,463 tons, of which 65,966 tons were exported. The previous highest total was 203,300 tons in 1923-24. Weather conditions during February showed some improvement but the rainfall was still below normal and its distribution was erratic. In some districts the young canes were showing the effect of the intense heat and good soaking rains were badly needed.

Discussing possibilities of World sugar consumption, Messrs. **Willett & Gray** point out that if the *per capita* consumption of the United States (107 lbs.) were taken as a basis of what might be achievable in the way of average world consumption, it would necessitate a world crop of about 80,000,000 tons, instead of the present 25,000,000 tons which gives a *per capita* world consumption of about 30 lbs. It seems very unlikely that coloured races will ever develop a consumption on the U.S. basis, but even so there is no doubt that the scope for further expansion of sugar consumption is very considerable.

The Most Important Loss in the Manufacture of Sugar from the Java Canes[1].

By WILLIAM E. CROSS, Ph.D.,
Director, Sugar Experiment Station, Tucumán, Argentina.

In the manufacture of sugar from the Java canes POJ 36 and 213, there is a source of loss which does not figure in the Factory Reports, but which nevertheless produces very serious losses, affecting both the factory and the cane grower, and producing enormous differences in their annual balances, in some cases even converting gains into losses. We refer to the loss produced by not grinding freshly-cut cane, owing to the deterioration which results between the cutting and the milling.

When other perishable products like milk, vegetables, etc., are concerned, the farmer never allows several days to pass before taking his products to market; but the cane grower, whose product is equally perishable, frequently allows himself the luxury of a considerable delay in delivering his cane to the factory, perhaps not realizing the great losses produced in this way.

This Experiment Station called attention to this peculiarity of the Java varieties so far back as 1914[2], and since that time has frequently insisted on this matter, without having been able to convince more than a part of the cane growers and factory owners in Tucumán of the absolute necessity of grinding these canes within one or two days of cutting.

That some *ingenios* still grind a good part of their cane in a deteriorated condition, we know from our own observations, as well as from conversations with superintendents of factories, and from many factory reports. We know some factories, for example, whose annual reports indicate a high Brix in the normal juice, for instance 18 or 19 per cent., with a purity of little more than 70 per cent., this being an indication of an exaggerated case of having ground old deteriorated cane instead of fresh cane, and indicating also a loss of several tenths of 1 per cent. in the yield of sugar per cent. cane obtained in the factory, as well as several hundreds of dollars—lost by the growers who supplied the factory with the cane.

Seeing that the degree of deterioration which the cane suffers after cutting depends on climatic conditions, it is impossible to establish an exact relation between the number of days which pass between cutting and milling, and the damage which the cane suffers; but, taking the average weather conditions of the crop in this country, we may arrive at figures which are very significant. The data which we will proceed to give are based on results obtained in the experiments of this Station[3].

LOSSES FOR THE CANE GROWER.

Immediately after cutting, the cane begins to suffer a loss in weight, for which reason even the grower who sells his cane without reference to its sugar content suffers a definite loss every day that passes between the cutting and the delivery of the cane to the mill. This loss results on an average between 1 and 2 per cent. of the weight per day. This means to say that the grower, who is accustomed to deliver his cane during the crop some 5 days after cutting, loses on the average between 100 and 200 lbs. on each ton. Or in other words, the grower who produces 10,000 tons of cane does not deliver more than 9500 or even 9000 tons to the factory, which implies a loss of several thousand dollars a year.

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[1] Circular 16, Agricultural Experiment Station, Tucumán.

[2] *Revista Industrial y Agricola de Tucumán*, 1914, 5, 277-290.

[3] *Idem*, 1916, 7, 219-250.

It will be seen that this loss is of sufficient importance to warrant a serious effort to avoid it. It is true that by keeping the cut cane well covered with trash the loss can be limited to some extent, and in cases where the delivery of the cane has to be delayed for reasons beyond the control of the grower, this procedure should always be followed; seeing, however, that this method does not eliminate the loss, but simply reduces it, it can only be considered an emergency measure for occasional cases.

If the grower sells his cane on the sugar content basis, in delaying the delivery of the cut cane he not only suffers from the loss in weight, but also from the reduction in sugar content that the cane suffers, of which we will speak in the next paragraph.

LOSSES FOR THE FACTORY OWNER.

If the loss in weight which is produced by the drying-out of the cane were not accompanied by chemical changes in the juice itself, there might be a certain advantage to the factory in receiving from the grower cane that had been cut some days, as the growers and cane cutters would be paid for a less weight of richer cane. But, unfortunately, there occurs an alteration in the sucrose content of the cane, which takes place simultaneously with the loss in weight, if not, indeed, even more rapidly. As the cut cane begins to "invert," the sucrose becomes converted into uncrystallizable products. This inversion is due to an enzyme produced in the cane, principally after it is cut, which increases in proportion day by day, producing a correspondingly greater degree of inversion from one day to another. In this way the rate of the inversion process increases in a kind of arithmetical progression, the amount of sucrose lost on the 6th day, for example, being much greater than that inverted during the 3rd day. For this reason, probably, during the first few hours after cutting (the number depending on the climatic conditions) the cane does not suffer any inversion at all. But the enzyme soon begins to form, and to produce the inversion for which it is responsible.

It may be said that under Tucumán conditions, cane which is left more than 48 hours after cutting incurs a very serious risk of loss of sucrose by inversion, and that after this interval the cane suffers, on the average, a daily loss of between 1 and 3 per cent. of its purity, according to the weather conditions.

The loss produced by this inversion is much more serious than would appear at first sight. In the first place, not only have we a loss in sucrose, but the sugar that remains in the juice is proportionately less available than it was. To explain this point we might take an example. A certain cane at the moment of cutting had the following composition (of the juice):—

	Per cent.		Per cent.
Brix	14·6	Glucose	9·6
Sucrose	11·8	Purity	80·8

Of this sucrose, 90·5 per cent. was available. Three days later the cane had lost 6·3 per cent. of its weight, and the analysis of its juice was as follows:—

	Per cent.		Per cent.
Brix	15·6	Glucose	1·0
Sucrose	11·9	Purity	76·3

Taking into account the loss in weight, the net loss of sucrose was 0·65 per cent., and of the sucrose that remained in the juice only 87·7 per cent. was available.

Besides the actual loss of sucrose produced by the inversion, and the lower availability of that left in the juice, the damage done to the cane is increased by the harmful effect of the substances produced by the deterioration, as the inversion of the sucrose is accompanied by other chemical changes in the juice. The substances referred to seriously affect the manufacturing processes, the juices of "inverted" cane being more difficult to clarify and filter, and the syrups more difficult to boil, than with freshly cut cane. More time is required for the several operations of the manufacturing process. For this reason the factory which works on the basis of cane cut some days suffers losses much greater than those indicated by the simple analysis of the cane, and also finds that its daily capacity is reduced and that its cost of production per lb. of sugar is increased.

The cane grower who sells his cane to the factory for a percentage of the sugar which it yields suffers a double loss if he delivers cane cut some days: the loss in weight, and the loss produced by the inversion. That is to say, the weight of the cane received by the factory is less than it was when it was cut, and the yield of sugar it produces is less than it would have produced if it had been milled without delay after cutting.

HOW THESE LOSSES CAN BE PREVENTED.

The losses produced by milling deteriorated cane are of such magnitude that even the most heroic measures are justified to prevent them. Some factories and growers have taken the necessary steps, but others have confined their efforts to trying to hurry up deliveries without modifying their organization, etc., in such a way as really to solve the problem. It is clear that the matter deserves the special attention of the managers of these factories, who ought to make radical changes in their methods of harvesting and delivering the cane in order to meet the case.

For example, in many parts the harvesting of the cane is done by men working individually, and paid by the weighed cart-load. Before a cart can be loaded the man himself must cut enough to fill it, which takes him between two and three days. The greater part of this cane is thus more than 24 hours old when the cart is loaded, and some of it much older. If the cane is cut by gangs of workmen on the other hand, the loading can proceed parallel with the cutting, in such a way that the cane is loaded within a very short time of being cut. It is our opinion that in all cases of cane taken to the mill in carts, it can be made to reach the factory within 24 hours of cutting.

When the cane has to be transported by rail, we admit that the problem of quick deliveries is a more difficult one, as it is true that in many cases serious delays are produced due to lack of waggons, or because the cane is moved slowly even after the waggons are loaded. But we think this is due in part to the fact that the railway authorities have not realized as yet the fact that the peculiarity of the Java cane to "invert" rapidly after cutting necessitates that it should be treated with the same preference as milk, vegetables, etc., the Java cane being in this sense very distinct from the old purple and striped varieties which were formerly planted here. It should be the function of the cane growers and factory owners and their unions and associations to educate the railway authorities and employees regarding this matter, in the hope that once they realize the perishable nature of these varieties of cane they will treat them accordingly, hastening their transport in every possible way.

As the transport of cane by rail implies a delay which is up to a certain point inevitable, it is especially important to be sure that this cane does not suffer any further delay in being loaded into the railway waggons, and later before being ground once it reaches the factory. If, as we have said, the cane taken to the factory in carts requires to be loaded the same day as cut, this is all the more necessary in the case of cane to be transported by rail. Nevertheless this is a point which is not always properly realized. We know of cases, for example, where the cane is loaded on to the railway waggons 4 or more days after cutting. We had to investigate a case in which the cane transported by rail to the factory always arrived in a very deteriorated condition. We were able to show that the rail transport required 3 days on the average, but that the cane was only loaded on the railroad waggons some 5 days after cutting. Thus with better organization regarding the deliveries of cane to the rail head, the loss through inversion suffered by this cane could have been reduced by much more than half. We wish to emphasize this point, as we have found that in some factories it is customary to lay the blame for the bad condition of the cane on the rail transport, without taking the necessary steps to prevent the avoidable delays in delivery to the railway waggons.

Seeing that with the system of loading in vogue in this country, chain slings are used for handling the cane, delays are sometimes produced by the fact that the growers have not received promptly from the factory the chains they need for loading. It is in the interests of the factory itself to organize its work in such a way that delays for this reason will be reduced to the lowest possible limit.

Even though for lack of waggons, or other reason, fortuitous delays are occasionally produced, the inversion suffered by the cane can be reduced to a great extent by employing the measures indicated by this experiment station some ten years ago.[4] At that time we showed that the cut cane placed in piles and carefully covered with trash suffers less than that exposed to the air, and that if this cane can be kept in a moistened condition, by throwing water over the piles of cane several times a day, the inversion can be reduced to a veritable minimum. In some cases the cane which is several days in transport by rail might be drenched with water by a hose or other means at several points on the journey: the organization of this practice would cost very little in comparison with the benefits it would produce. And in the case of a breakdown in the factory, the cane should not be left in the fields, but should be accumulated in the factory yard, where the piles should be drenched with water two or three times a day at little expense.

In conclusion, we will repeat a recommendation which was also made by us several years ago. In our investigations, to which we have referred, we were able to show that the rate of deterioration after cutting varies very much with the variety of cane, some varieties suffering comparatively little in this respect, in contrast to the POJ 36 and 213 which are among the canes that invert most rapidly. If therefore because of the distance of his plantations from the factory or for other reasons, a grower knows that his cane will always have to suffer a considerable delay between cutting and milling, he should not cultivate these rapidly inverting varieties, but rather those which we have shown to invert only slowly even after being cut many days; such, for example, as POJ 2725, POJ 228, D 1135, and the old purple and striped canes, the first mentioned of which we consider the best under ordinary conditions.

It was elicited recently in Parliament that the management of the Cantley, Ely and Ipswich beet factories bought for their 1925-26 campaign 32,000 pulp bags, all English, and 398,000 sugar bags, of which 223,000 were British and the balance Continental.

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[4] *Loc. cit.*

Pre-Evaporators.[1]

Pre-evaporators, properly so called, are evaporators—usually, though not always, single-effect only—in which the raw juice is partially concentrated before going to the main evaporator, and which have steam and vapour connexions independent of the latter. The name is, however, often applied to any evaporating vessel introduced in order to assist the main evaporator, and this wider definition may be accepted here, especially since, with cane sugar factories, the question most usually arises in connexion with increasing the capacity of an existing evaporator.

True pre-evaporators, though common in beet sugar factories, are not often installed in cane sugar factories. The vapour from a pre-evaporator may be utilized in juice heaters or in calandria vacuum pans, of which the former are usually the most advantageous. In a beet factory the juice flow is entirely under control, and a steady rate is maintained, so that the pre-evaporator and the juice heater work together uniformly and continuously; but in a cane factory the mill work, and hence the juice flow, are always irregular to some extent, and a stoppage of the juice flow through the heater at once slows down or stops the working of the pre-evaporator, unless the vapour is blown to atmosphere, which, of course, is only done as a last resource.

The arrangement and connexions for a pre-evaporator in front of a triple effect evaporator are shown in Fig. 1. In the case where a factory has a surplus of exhaust steam at a pressure of 5 lbs. per sq. in. or more, which is wasted to the atmosphere—a condition which even to-day is of occasional occurrence—a pre-evaporator may with advantage be installed, and the vapour from it sent to atmosphere.

The installation of a true pre-evaporator is the cheapest method of increasing the evaporative capacity of a factory, so far as initial outlay is concerned, but the working economy is not generally very satisfactory under the conditions usual in cane sugar factories.

The second method of increasing the evaporative capacity of a factory, which is completely satisfactory in operation, and reasonably low in first cost, is to add a second "first vessel" to the evaporator, to work in parallel with the original or first "first vessel": this is often called a pre-evaporator, but is not really such, and the ultimate working of the enlarged evaporator is exactly the same as that of an ordinary evaporator with the first vessel larger than the others, an arrangement which was deliberately adopted with satisfaction in many cases thirty years ago and more.

With this arrangement of an additional first vessel, no vapour is ever wasted to the atmosphere, as it can all be condensed in the second vessel of the evaporator, the only effect being a slight alteration to the temperature distribution. It is, however, customary to instal juice heaters for utilizing part of the vapour, which gives additional economy of working, as well as additional evaporative capacity. The advantage of this arrangement, shown in Fig. 2, is that stoppage of the juice flow through the heaters has scarcely any effect on the evaporation, as the temperature distribution in the evaporator automatically adjusts itself to suit the amount of steam bled to the heaters.

The initial cost of this second arrangement (without juice heaters) is substantially the same as that of the first, but it has several advantages for cane factory work, so that it is the most popular, and generally the best method of providing additional evaporative capacity.

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[1] Extracted from a leaflet on "Pre-Evaporators" prepared by Mr. P. H Parr, and issued by Messrs. Blair, Campbell & McLean, Ltd., of Govan, Glasgow. Readers wishing for copies of this paper with further particulars should apply to this firm, asking for Leaflet No. 111.

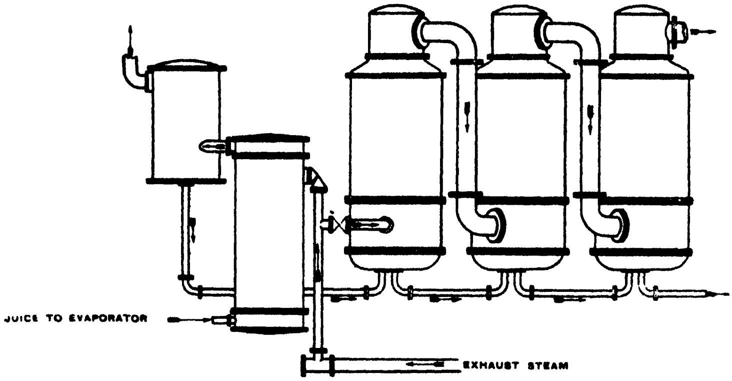

FIG. 1

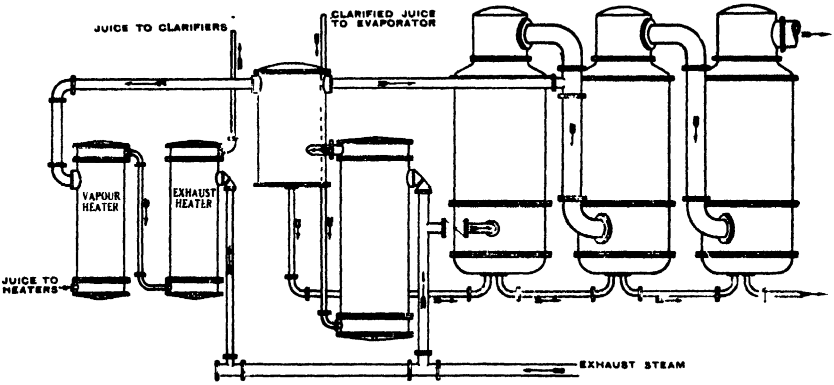

FIG. 2

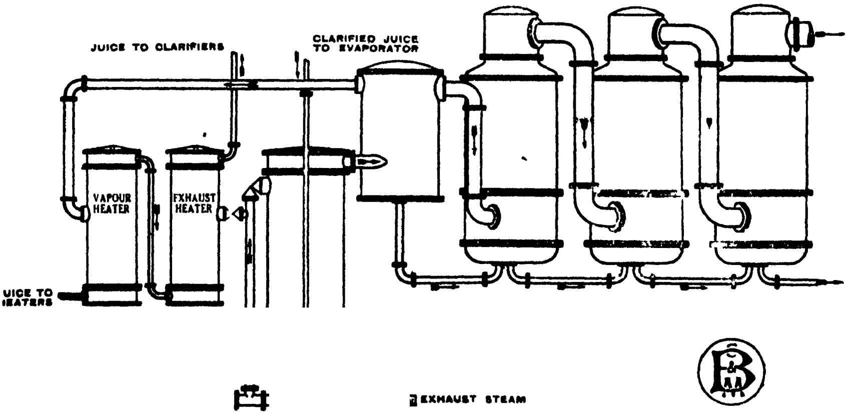

FIG. 3

A third arrangement is employed where there is a shortage of steam as well as of evaporative capacity, and consists of transforming the triple effect into a quadruple effect by the addition of a new first vessel, with sufficient surface to take care of the extra evaporation required as well as surface equal to that in one of the old vessels, to deal with its share of the evaporation of a quadruple effect. The vapour from the new vessel goes, generally, to the calandria of the old first vessel, which becomes the second in the quadruple, but part of it may, with advantage, be bled for juice heating just as mentioned above, and the arrangement is shown in Fig. 3. This gives the most economical method of working, but is the most costly to instal.

In order to show clearly the differences between the three methods, we propose to give approximate calculations for each, taking as a basis a cane sugar factory crushing 20 tons of cane per hour, and giving 3800 galls. of mixed juice per hour at a density of 16° Brix (9° Bé.); it is also assumed that the juice is to be concentrated to 55° Brix (30° Bé.); that the existing triple effect evaporator has a total heating surface of 3300 sq. ft. and can evaporate 7½ lbs. per sq. ft. per hour.

It is easily found that the evaporation required is 28,600 lbs. per hour, whilst the triple can only evaporate 3300 × 7½ = 24,750 lbs. per hour (which would only concentrate the juice to 41° Brix or 23° Bé.), so that 28,600 — 24,750 = 3850 lbs. per hour must be evaporated by the pre-evaporator.

For the first case of a true pre-evaporator using exhaust steam at 5 lbs. per sq. in. and discharging the vapour to atmosphere or to juice heaters (when working) at atmospheric pressure, we may expect an evaporation of about 5½ lbs. per sq. ft. per hour, so that a pre-evaporator of 3850/5½ = 700 sq. ft. heating surface will be required. If live steam at 10–15 lbs. per sq. in. can be used, the surface may be reduced to 400 or even 350 sq. ft.

For the second case of an additional first vessel, working in parallel with the existing one, the evaporation will be approximately the same as for the triple, or 7½ lbs. per sq. ft., so that we shall require a vessel having 3850/7½ = 515 sq. ft.

For the third case of conversion to a quadruple effect evaporator, we may take the evaporation of a quadruple at about 5½ lbs. per sq. ft. per hour, so that there will be required a total heating surface, for all the juice, of 28,600/5½ = 5200 sq. ft., and as the existing triple has 3300 sq. ft., the new first vessel must have 5200 — 3300 = 1900 sq. ft., or about 1¾ times the surface in one of the existing vessels.

Regarding the relative economies of the three methods, if we assume that 1 lb. of steam will evaporate 0·9 lb. of water at single effect, 2·6 lbs. at triple effect, and 3·3 lbs. at quadruple effect, then the first scheme will require 24,750/2·6 = 9520 lbs. of exhaust steam per hour for the triple, and 3850/0·9 = 4280 lbs. of either exhaust or live steam for the pre-evaporator, a total of 13,800 lbs. per hour; the second scheme, being really a triple effect, will require 28,600/2·6 = 11,000 lbs. of exhaust steam per hour; and the third scheme, of quadruple effect, will require 28,600/3·3 = 8650 lbs. of exhaust steam per hour. (If bleeding for juice heating is done, these figures will be increased.)

A further method of working a true pre-evaporator is to use steam at 20–25 lbs. per sq. in. and boil the juice under a pressure of about 5 lbs. per sq. in., the vapour being passed to the exhaust main. This, however, is not usually to be recommended except for large factories working under close technical control, as the high temperature may cause inversion and discoloration of the sugar.

Beet Sugar Manufacture in the United Kingdom.

On April 14th at a Joint Meeting of the Institution of Chemical Engineers and the Chemical Engineering Group of the Society of Chemical Industry, Mr. J. **Kwantes**, Manager of the Cantley and Kelham beet sugar factories, gave an excellently clear account of the general principles of beet sugar manufacture.

He outlined the processes of washing the roots; extracting the juice; clarifying the juice; evaporating the juice; and crystallizing and centrifuging the massecuite, in a manner well suited to his general audience of engineers and chemists, illustrating types of plant in general use by means of some good lantern slides.

Most of this information will be known to our readers, though notes may be made of some points mentioned here and there in the lecture. He stated, for example, that decolorizing carbons are coming more and more into use in white beet factories, that their possibilities appear to be very great, and that there is no doubt that in future they will play a very important part in the sugar industry.

In present practice the juice draw-off amounts to 100 to 115 litres per 100 kg. of roots, which juice contains about 15 per cent. of sugar (by weight), with 17 or 17·5 per cent. of total solids, and consequently a purity of between 85 and 89°. At this stage the loss of sugar is 0·2 to 0·5 per cent., depending on the manner in which the diffusion is operated. The spent slices on leaving the battery contain only about 5 per cent. of solid matter, and the pulp must be dried down so that only 10 per cent. of water remains if it is to be kept.

In clarification the lime may be added dry, or as milk, or again as sucrate, each method having advantages. Actually the amount of lime added in practice is 1·5 to 2·5 per cent. of the roots, although the quantity necessary to effect the chemical changes involved is only 0·5 to 0·75 per cent., the rest being required to make a sufficiently bulky precipitate to eliminate substances hindering filtration. After the first carbonation the juice running from the presses has an alkalinity of about 0·1 grm. of CaO per 100 c.c., this after the second operation being reduced down to 0·02 to 0·04 per cent. Cake in the first carbonation presses contains 6 to 8 per cent. of sugar, which is washed down to 1 per cent. As the result of the carbonation process, the purity of the juice is raised from 3 to 5°, reaching thus 92 to 93° (as an average).

In the evaporators about 75 per cent. of the water present in the clarified juice is eliminated, the sugar content being thus increased from 15 to 55-60 per cent. In the vapour from the boiling juices, ammonia gas is present. If it could be recovered, one would be able to obtain 2 to 4 cwt. of ammonia (as NH_3) from every 1000 tons of roots sliced.

In making white sugar, the after-products (second or third crops of sugar) are re-dissolved in water or thin-juice to a saturated solution, and drawn into the pan, often after being treated with some decolorizing carbon. Some 2 to 2½ per cent. of sugar is left in the molasses, unrecovered, unless one of the de-sugarization processes is applied.

A beet factory may have a capacity from 700 to 1500 tons of beets per day. It may consume 7000 to 15,000 tons of coal during its three to four months' campaign. It may require 1 to 1½ h.p. per ton of beets worked during 24 hours. And it may employ 400 to 600 men working in three shifts during the campaign, 40 to 100 remaining after the season for overhauling and cleaning up. In the modern beet factory automatic recorders, density meters, automatic CO_2 apparatus, steam and temperature and other such devices are in general use. Its technical and chemical control are of great importance, and an efficient staff of analysts is required for effecting numerous analyses at the several stages of the process.

DISCUSSION.

Mr. **ALFRED WOOD**, Secretary to the British Sugar Beet Society, who opened the discussion following the reading of the paper, said that Mr. **KWANTES**, who was manager of the Cantley and Kelham factories, had probably had more to do with beet sugar manufacture in England for many years past than anybody else. The Cantley factory had struggled for a few years by itself until Kelham came on the scene, and to-day there were ten beet sugar factories in this country, whilst the number would soon be fifteen. More than 128,000 acres of beet were being grown, and this year would be the largest campaign that had ever been experienced in any year, because over one million tons of beets would be converted into home-grown sugar.

Mr. R. T. **TRINDER**, of the Cantley Factory, said that "Norit" was in use there. Thick-juice as it left the evaporator and went to the vacuum pans was treated with "Norit," the amount of which varied with the quantity of juice and also with the impurities in the juice. In any case the quantity was very small, and did not run into more than 0·5 per cent.

STORAGE OF DEHYDRATED BEET.

Mr. A. J. V. **UNDERWOOD** said it would be interesting to hear something on the economic prospects of the beet sugar industry in this country. The question was what would be the position of the industry when the subsidy came to an end? The present cost of the production of sugar beet was estimated at about 45s. per ton, whilst the price paid on the Continent for sugar beet was about 20s. to 25s. per ton, which left a very big difference to be made up. It would be interesting to hear the author's opinion as to a process which was attracting a certain amount of attention, namely, the drying of the beet before the extraction of the sugar. The pioneer work on that process had been done in Italy, and it had been found that by reducing the moisture content in the beet from 80 per cent. to about 3 per cent., the beet slices could be stored more or less indefinitely.

Mr. G. **SCHACK-SOMER** said the Italian process of drying beetroots was an old process, and he remembered it so far back as 25 years ago. Although it had advantages, there were also disadvantages, not only the extra cost of evaporating the water. He did not believe there was the advantage from the point of view of labour as had been suggested.

Dr. W. R. **ORMANDY** said we were hearing a great deal about developing a sugar industry in this country, aided by a bounty which was equal to, or rather in excess of, the price at which the Continent sold us the same sugar before the war, but it was another example of the way in which we neglected fundamental research. The difficulties of sugar manufacture depended on the great care exercised in the diffusion process, and he would like very briefly to describe some experiments carried out by his friend, Count **SCHWERIN**, ten years ago, but which, owing to his death, were never carried any farther. It was an electrical process with an anode and cathode, and the use of the electric current caused sugar to pass from cell to cell and to be collected. In that way it was possible to get 90 per cent. of the sugar out of any solution, giving a concentration equal to, if not greater than, that produced by any well run diffusion battery. Another speaker said that the sucrose content of the roots was roughly 16 to 17 both on the Continent and here. The average weight of the beet grown in this country was gradually increasing. At the beginning it was about 300 grms., but that had been increased now to an average of about 600 grms.

Mr. FOWLER described briefly the method adopted when beet was sent to the factories at Cantley, Kelham, Ely and Ipswich for arriving at the tare of the vehicles. Experience had shown that on the average the method was not very far out. It had been stated that the farmers were dissatisfied in some cases with their tares, but he was afraid that farmers would always grumble. Furthermore, in the case of Cantley there were three growers' representatives appointed by the National Farmers' Union to look after the interests of the grower, and these three representatives had free access to the department dealing with tares.

METHODS AT ELY FACTORY.

Mr. WILLEMSTIJN said the Ely Factory was built last year, and was working the same methods as at Cantley. The Steffen process, together with the diffusion process for making white sugar, was adopted, but "Norit" was not being used, and they were making white sugar without any decolorizing carbon. The plant was the same as at Cantley, and all the experience obtained at Cantley had been adopted in the operations at Ely. The factory there was built for a capacity of 1200 to 1500 tons per day, and they were very pleased last year to find that they were able to deal with 1700 tons per day, which it was hoped to increase to 2000 tons per day of 24 working hours this year. On the Continent the factories did not work for more than 70 days, but owing to the milder climate in England it was hoped to be able to work the Ely factory a month longer than was the case on the Continent.

POWER ALCOHOL FROM BEET MOLASSES.

The President said the question of the production of sugar from beet in this country had been of considerable interest to him for some years from a subsidiary point of view. It was a conservative estimate to say that the quantity of molasses available from the treatment of one million tons of beet annually would amount to something like 3 per cent., and if we took 70 galls. of 95 per cent. alcohol per ton of molasses (which was the figure the distillers got from molasses in this country), we had an alcohol production of 3½ million galls. Though this sounded a good deal, it could hardly be looked upon as adding materially to the home production of liquid fuels. Last year the quantity of petrol imported into this country was over 500 million galls., but alcohol was now becoming of some importance as an addition to petrol for anti-knock purposes in motor car engines.

Mr. KWANTES, replying to the discussion, said that he himself had carried out experiments on dried beet, but had never been able to obtain the same percentage of sugar from it as from fresh beet. The amount was usually from 10 to 12 per cent., as against 16 to 18 per cent. One other thing he found was that if the water content was more than 3 per cent., the keeping conditions of the beet were very bad indeed. In fact, it started to heat up ; at a temperature of 100°C., it became a black mass, which had to be broken to pieces with a pickaxe, and nothing could be done with it. With reference to the Steffen juice extraction process, although it was not mentioned in the paper, this method was used at Cantley in conjunction with the diffusion process. Fresh slices were pressed to remove 40 to 60 per cent. of the juice, and they were afterwards sent to the diffuser, where further juice was extracted and the final pulp obtained, which only contained 0·1 to 0·3 per cent. of sugar. He had only explained in the paper the simple principles of the beet sugar industry, and had not stated precisely how the factory at Cantley worked. As a matter of fact, at Cantley (as stated by Mr. TRINDER) the raw sugar was treated with decolorizing carbon, quickening the production of white sugar. He agreed that, from the theoretical point of view, too much lime was being used for epuration. It only actually required 0·5 to 0·75 per cent. of lime, but to obtain an easily filterable juice there must be an excess, and at the moment the process employed had not reached the stage when an excess of lime could be avoided.

Decolorizing Carbons: their Comparative Value and their Suitability for Sugar Refining.[1]

By A. A. BLOWSKI and J. H. BON,
California and Hawaiian Sugar Refining Corp., Crockett, Cal.

DESIRABILITY OF CARBONS FOR REFINING.

In the bonechar process, char filtration serves a dual purpose—it decolorizes the high-purity liquors, and removes a large part of the colour and soluble non-sugars from the low-grade products. This elimination of non-sugars, which commonly amounts to approximately 1 per cent. on the melt, results in a reduced molasses production and a consequent increased sucrose recovery, and is one of the outstanding advantages of the bonechar refining process. In a refinery melting 500,000 tons of raws per year, the value of the sucrose recovered as a result of char filtration is approximately $450,000, based on a value of 5 cents per lb.

To summarize the main points involved, the outstanding advantages and disadvantages of the bonechar and decolorizing carbon processes are enumerated as follows :

The bonechar process, which is established as the standard process for the refining of sugar, possesses the following important advantages :—

(*1*) *Elimination of non-sugars.*—In the bonechar filtration process approximately 1 per cent. non-sugars on melt is eliminated, resulting in a decreased molasses production and an increased sucrose recovery amounting to about 1 per cent. in melt.

(*2*) *Ease of regeneration.*—Spent bonechar may be readily restored to practically its original efficiency by a process of washing and kilning, which involves small losses and is easily controlled.

(*3*) *Small replacements.*—The replacement of char due to shrinkage and dust removal is small—in a carefully managed plant amounting to between 13 and 15 per cent. per annum of the char in process.

(*4*) *Highly developed technology.*—As the process is already highly developed, there is no difficult and expensive period of pioneer work to be gone through before it can be considered successful.

But a number of equally evident disadvantages may be enumerated :—

(*1*) *Large investment in plant.*—The expensive char equipment and the large amount of char in process necessitate a large investment of capital in a bonechar refinery.

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[1] Extracted from a paper entitled "Decolorizing Carbons," published in *Industrial and Engineering Chemistry*, 1926, 18, No. 1, 32-42. The first part of this paper, dealing with analytical methods, is abstracted elsewhere, while the preceding portion on carbons was summarized last month, pages 203-208

(*2*) *Large amount of material to be handled.*—In the bonechar filtration process there is a great bulk of bonechar and liquor in process at all times.

(*3*) *Large wash-water consumption.*—For the washing of the exhausted bonechar a large quantity of hot water is necessary.

The following arguments in favour of the decolorizing carbon process are advanced: (1) Simplicity of process; (2) reduced inversion losses; (3) smaller investment necessary; (4) small wash-water requirements.

Against these advantages must be balanced the following disadvantages:—

(*1*) *Low non-sugar elimination.*—The non-sugar elimination obtained with the carbon process is for all practical purposes negligible, because the amount of carbon used to effect decolorization is very small and only high-purity liquors are treated.

(*2*) *High losses in regeneration.*—It is stated by producers of carbon that the losses in the regeneration process amount to not more than 5 per cent. per cycle. This can probably be safely interpreted as meaning that the losses will amount to at least 5 per cent. per cycle. It can readily be seen that with the price of carbon over $300 per ton the replacement cost is no small item in the cost of manufacture.

(*3*) *Increased remelt boiling.*—Because there is a negligible elimination of non-sugars in the carbon process, calculations show that the burden on the remelt pans would be increased by at least 140 per cent., necessitating a proportional increase in operating expenses on the remelt station. Also, the additional equipment required to handle these remelts would offset a considerable portion of the saving in investment secured by the elimination of the char equipment.

FEASIBILITY OF CARBON PROCESS.

This is discussed from two standpoints—a consideration of the possibility of the use of the carbon process, and a consideration of the problems to be overcome before its success is assured.

Possibility of use of carbon process.—It is assumed that in the carbon process the raw sugar would be washed to 99° purity or higher, and melted to 60° Brix. The clarification and decolorization of the resulting melt liquor would be combined in the carbon treatment, producing a granulated liquor by multiple carbon filtration (used to reduce the amount of carbon required to effect decolorization). The affination syrup (a dark syrup of about 80° apparent purity secured from the washing of raw sugar and containing the bulk of its impurities) and concentrated sweet-water would presumably be disposed of by boiling directly to remelts, the remelt sugar liquors then to be decolorized with carbon and sent to the granulating pans.

Direct treatment of affination syrup and concentrated sweet-water with carbon would be unwise for the following reasons:—

(1) The value of sucrose recovered as a result of elimination of non-sugars would not cover the cost of the carbon treatment; (2) the resulting liquors, even if sufficiently decolorized, would not be of high enough purity to produce a good quality of granulated sugar—as purity is as important as colour in a white refined sugar: (3) the filtration of unclarified low-grade liquors through carbon would undoubtedly seriously impair the carbon efficiency.

In order to determine whether a satisfactory granulated liquor can be produced by multiple filtration of raw liquor with carbon, the following decolorizing tests were made: 500 c.c. portions of washed raw sugar liquor, of 60° Brix and 16·67° Stammer were treated with carbon for ½ hour at 80° C., and filtered on a Büchner funnel. Fresh carbon was used to effect the final decolorization, this carbon being re-used on partially decolorized liquor and used a third time on unfiltered melt liquor.

This laboratory test approximates to the three-stage decolorization process to which the melt liquor would be subjected in actual operation. Colour determinations were made at each stage of the decolorizing process with the following results:—

	FIRST FILTRATION (with twice-used carbon)			SECOND FILTRATION (with once used carbon)			THIRD FILTRATION (with fresh carbon)		
Per cent carbon used	Stammer colour	Cube colour	Per cent. colour removal	Stammer colour	Cube colour	Per cent. colour removal	Stammer colour	Cube colour	Per cent. colour removal
1	5·66	—	66·1	1·59	—	90·5	0·66	1600	96·0
2	2·23	—	86·7	0·72	—	95·6	0·25	600*	98·5
3	1·39	—	91·2	0·30	750*	98·2	—	—	—

* Satisfactory granulated liquor.

The colour of very light granulated and specialty liquors is determined by comparison with a dilute potassium dichromate-cobalt chloride solution, termed "C. & H. cube colour standard," which has a colour corresponding to a very good quality of specialty liquor, from which cube sugars and confectioner's sugar (large crystals) are produced, and is arbitrarily rated at 100 on the cube colour scale.

These tests indicate that a satisfactory granulated liquor can be produced from washed raw sugar liquor by applying 2 per cent. of carbon on melt in a three-stage decolorization process. Although various carbon manufacturers state that washed raw sugar liquor is almost completely decolorized when treated with 1 to 2 per cent. carbon in a one-stage process, the writers have never been able to produce anything approaching a refinery granulated liquor with less than a three-stage process.

It will be seen from the results that the liquor produced by a three-stage process contained six times as much colour as a good quality specialty liquor. Further tests indicated that it is possible to produce a liquor approximating but not equal to the quality of this company's specialty liquor, from which cube sugar and confectioner's sugar (large crystals) are produced, by an additional treatment of granulated liquor with 2 per cent of carbon. However, little is known of the quality of the residual colour in liquor decolorized by carbon. Liquors containing very minute quantities of certain types of colouring matter are known to produce specialty sugars of a very undesirable colour. Whether or not the residual colour in carbon-filtered liquors is of this nature would have to be determined by large-scale tests.

The foregoing laboratory tests indicate that by using the carbon process it would apparently be possible to produce a granulated sugar which compares favourably with standard bonechar granulated, but that the production of satisfactory specialty sugars is somewhat problematical.

Problems in substituting the carbon process.—As is the case with any new process, the adoption of the carbon process would undoubtedly be attended with a host of difficulties, many of which would be serious enough to completely demoralize an enterprise until they could be solved, the most serious of these problems being:—

Speciality sugars—i.e.. cube sugar and confectioner's sugar (large crystals)—make up a small but very important part of the output of every refinery. It has already been noted that the production of good specialty sugars by the carbon process is more or less problematical.

Soft sugars also form a very necessary part of the refined output, and, in addition, are very profitable. It has never been demonstrated, to the writer's knowledge, that good soft sugars—i.e., sugars possessing satisfactory flavour, colour, bloom, keeping qualities, and the required polarizations—can be produced from carbon-treated liquors. Probably very extensive investigation would be necessary to solve this problem.

Carbon used on unfiltered liquors suffers a gradual reduction in filtration efficiency, owing to the formation of very fine secondary carbon in the regeneration process. The maintenance of the filtration efficiency of carbon in process is a problem which would have to be solved to insure uniform operation of the plant.

It is stated by the manufacturers that carbon in process requires a periodic acid regeneration to reduce its ash content and restore its decolorizing efficiency. The effectiveness of this treatment, and the frequency with which it is necessary would develop only in the operation of the carbon process. The chemical treatment of carbon would therefore be an uncertain item in the expense of the process.

It is known that failure to remove the last traces of carbon from decolorized liquors results in the production of specky sugars or sugars with a grayish cast. It would probably develop that in order to insure absolute clarity a final filtration of decolorized liquors with a standard filter aid would be necessary. This would necessitate additional filter-press capacity and considerable added expense.

On the basis of experimental data, the production of a standard granulated sugar by the carbon process appears possible. But the production of specialty sugars—i.e., cube sugar and confectioner's sugar (large crystals)—and soft sugars is problematical, and there are other problems involved in the operation of the process which are of sufficient importance to jeopardize its success when applied on a refinery scale.

It is evident, therefore, that it would be most inadvisable for an established char refinery to scrap its equipment and substitute the carbon process, or even for a new refinery to install the carbon process, unless it showed the prospect of a very substantial financial advantage and until material progress is made toward the solution of the above problems.

ECONOMIC COMPARISON OF THE TWO PROCESSES.

In addition to scrapping char equipment, and installing carbon plants, the facilities for handling remelts—i.e., low-grade pans, mixers, centrifugals, and syrup tanks—would have to be increased to provide for at least a 140 per cent. increase in remelt massecuites to be boiled. It should be remarked that with the use of char approximately 50 per cent. of the entering non-sugars is eliminated, a further 15 per cent. diverted to the soft system, and the remaining 35 per cent. is handled as remelts. With the carbon process 15 per cent. would be diverted to the soft system and the remaining 85 per cent. of non-sugars would have to be handled at the remelt station. This amounts to a 140 per cent. increase in non-sugars to the remelt station.

Probably discontinuance of cloth filtration of low-grade products would make available sufficient filter-press capacity for the two refiltrations of the carbon-treated melt liquor.

Thus, the conversion of an existing bonechar refinery into a carbon refinery would involve the loss of the greater part of the capital in bonechar equipment, and would require the investment of additional capital to provide carbon regenerating equipment and increased low-grade boiling equipment. The erection of a new carbon refinery, however, would require a smaller investment of capital than a bonechar refinery of the same capacity.

Comparison of costs.—The following tabulation is a very approximate comparison showing the difference in costs of refining by the bonechar process and by the carbon process. The available cost data for the bonechar process are quite exact, but the figures for the carbon process are at best only estimates, hence liable to considerable error. For obvious reasons, the detailed statement of operating costs is not included in this report, merely the differences in costs of the two processes being shown:—

Difference in Costs of Bonechar and Carbon Processes.
(Based on a melt of 500,000 tons per year)

	Carbon Process	
	Dr.	Cr.
(1) Saving in operating expenses in carbon process, blowups to pan tanks		$314,000
(2) Savings in wash-water costs in carbon process		180,000
(3) Savings in fixed charges, due to smaller capital investment, carbon process		100,000
(4) Value of increased molasses production, carbon process		70.000
(5) Value of sucrose lost as molasses, due to lack of elimination in carbon process (based on 1 per cent. non-sugar elimination, with sugar at 5 cents. per lb.)	$440,000	
(6) Cost of increased remelt boiling in carbon process	200,000	
	$640,000	
(7) Balance in favour of carbon process	24,000	
	$664,000	$664,000

No allowance is made for saving due to a possible reduced inversion of sugar with the carbon process, because this cannot be estimated. In fact, such figures as have been published indicate that the losses are much larger with the use of decolorizing carbons than with bonechar, though it is possible that this is due to poor plant control. However, if such saving exists it is not believed to be very large.

In assembling the first item above, the cost of decolorization in the carbon process—i.e., three filtrations of melt liquor with 2 per cent. carbon—was assumed to be equal to the cost of clarification in the bonechar process, less cost of filter aid used. The two refiltrations of melt liquor are estimated to equal the cost of the low-grade clarification practised in the bonechar process, and eliminated in the carbon process.

The cost of regenerating carbon is estimated from cost figures included in a report by Tillery,[1] and from the cost of parallel operations in the char-kilning process. It is to be noted that the largest single item in the cost of the carbon process appears to be the expense for replacement of carbon.

The third entry in the tabulation of comparative costs is the net saving in fixed charges to be credited to the carbon process, as a result of the smaller capital investment required. On balancing the cost of the char equipment and the additional buildings required in the bonechar refinery against the cost of carbon-regenerating equipment and the additional low-grade boiling and handling equipment required in the carbon refinery, there appears to be a saving of approximately $1,000,000 in capital invested, in the case of a carbon refinery melting 500,000 tons per year. Interest and depreciation on this sum is figured at 10 per cent.

In the carbon process there is no appreciable elimination of non-sugars, as in the bonechar process. Consequently, there is a considerable loss of crystallized sucrose, and an increased production of molasses. Item 4 represents the value of the increased molasses production, credited to the carbon process, and item 5 represents the loss of recoverable sucrose as molasses, debited to the carbon process. These figures are based on a non-sugar elimination of 1 per cent. on melt (in the bonechar process), with crystallizable sugar valued at 5 cents per lb. and sugar in molasses valued at 0·8 cent per lb.

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[1] *Louisiana Planter*, 1921, 67, 9-14; *I.S.J.*, 1922, 479.

Item 6 represents the cost of the increased remelt boiling necessary in the carbon process. Because there is no appreciable elimination, the quantity of non-sugars to be handled at the remelt station is increased by 140 per cent., and the operating costs are increased proportionately.

It will be seen that the decolorizing carbon process appears to offer a slight saving—so small, however, that, in view of possible errors and oversights, it must be considered a balance. On the other hand, unforeseen developments might increase the cost of the carbon process and the special problems arising might take years for solution, making it difficult or impossible for the refiner to compete in all markets. It is evident, therefore, that if a refiner were to adopt such a process he would be assuming a great risk with his investment and yet would have practically nothing to gain, if successful.

CARBONS AS ADJUNCT TO CHAR.

In such a scheme it is assumed that the melt liquors would be decolorized with carbon, the clarification and decolorization being combined in the carbon treatment. Satisfactory decolorization would be obtained by using 2 per cent. carbon on melt, with three filtrations. Syrups and low-grade liquors, after cloth filtration, would be filtered over bonechar.

The decolorization of melt liquors by carbon would release approximately 12 per cent. of the char which is normally tied up with raw liquor filtration. This would permit the revivification of a larger quantity of char per unit of melt, more intensive char filtration of low grades, and consequent increased non-sugar elimination.

In the combined carbon and bonechar process, the production of soft sugars and specialty liquors would present no serious problem. Soft sugars would be produced from char filtered liquors and, if necessary, a portion of the char could be reserved for specialty liquors.

The cost of refining by this process would be equal to the sum of the operating costs in the decolorizing carbon process and the costs in the bonechar process, less the cost of clarifying melt liquor included in the char process. This would result in a refining cost for the combined bonechar-carbon process of about $400,000 per year more than for the bonechar process alone, on the basis of the 500,000 ton annual melt considered above.

The sole advantage of the combined bonechar-carbon process would therefore be the increased non-sugar elimination and consequent increased sucrose recovery, due to more intensive char filtration of low-grade liquors. To offset the increased cost of the combined process, it is evident that this increased sucrose recovery would have to amount to $400,000 per year. This would necessitate a 90 per cent. increase in non-sugar elimination, which experienced refiners will recognize as an impossibility.

It must therefore be concluded that the combined bonechar-carbon process presents no prospect of saving over the simple bonechar process.

Economics of Plantation Railways.[1]

By H. V. CAMPBELL.

TRANSPORTATION AND GRINDING.

The milling of sugar has been developed to great efficiency in extracting cheaply the largest possible percentage of sugar from the cane. On the other hand, methods of transporting cane from the field to the mill have advanced but little. Even the methods now in use have not been brought to their highest efficiency. It is generally admitted that there is not much room left to increase mill efficiency, and the place to look for future savings is in transportation and the handling of the cane.

Probably the reason that the handling of cane has not advanced as rapidly as it should have is that there are no salesmen being sent out to advocate efficiency in methods of transportation, although this would not necessarily mean new machinery to be sold to pay for the salesmen's services as would the application of new methods at the mill. The buying of transportation equipment is usually based on the actual needs of the system in use to carry on the crop and not on an introduction of a change of methods as in the milling of it.

In view of the wide difference in various localities, in labour wage, ability and hours, it is difficult to compare costs of cutting, handling and moving cane. Then, also, the transportation question varies in different countries and localities, as does the rainfall, prices of work animals, roads, etc. Economies in transportation are locally developed by the manager and the transportation staff. Improvements in transportation methods are not widely advertised, as is a device that can be sold, and it is generally accepted that almost any one can build and operate a cane railroad economically, but it will frequently be found that economy is omitted when results are checked.

LOCATION.

Locating a railroad is giving to it its constitution. It may be sick almost unto death with accidents of construction and management, but with a good constitution it will ultimately recover; this applies to cane as well as to commercial roads. The ideal location is to arrange for a straight line between stations and a uniform grade, but economic location demands the proper relation between construction and operating expenses. For a plantation railway, the best location is one that reduces the amount of annual operating expenses and interest on the construction costs to a minimum. Locating such a line takes into consideration, as opposed to the construction of the *cheapest* line possible, that the cost of lifting a ton 1 ft. equals the hauling of a ton 333 ft. over level track, and that the resistance of every degree of curve per 100 ft. is equivalent to hauling 16 ft. on a straight track.

The usual loaded haul on cane railroads is in the direction of the mill, which permits of a heavier grade *from* the mill but only up to the point where the engine can haul as many empties out as it can haul loaded cars in.

MAINTENANCE.

Many Centrals do not employ an engineer for railroad location work and construction, let alone maintenance. Usually an experienced track foreman or superintendent can keep the track in as good a condition as an engineer, but the question that arises in the mind of the Central manager is: What return will he get on money put into track material and maintenance, and should this money be spent on material or labour? In other words, the economical amount to be spent on material and labour, as money so spent will make a great difference to permanent track conditions, which, in turn, affect operating and maintenance expenses. These are matters that require the attention of an engineer.

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[1] From *Sugar Central and Planters' News*, 1926, page 784. Here slightly abridged.

Track should be kept in such condition that it permits maximum engine loading and maximum economic speed in train operation. If there is little or no ballast, widely separated ties, light rails and poor drainage, the labour cost of maintenance becomes exorbitant, and necessitates the use of labour for track maintenance at a time when it is badly needed in the canefields. If the road-bed is left defective, there are operating losses due to slow speeds, engine traction loss, and the necessity for the use of light trains. On the other hand, if track is brought to a condition equalling a first-class commercial railroad, interest on the investment in ballast, ties, rails, and bridges would be greater than the labour costs of keeping up a cheaper road-bed. Therefore, the line having a minimum of labour upkeep costs and interest on material costs is the most economical.

On one Hacienda the money allotted for maintenence was not sufficient to keep the track in condition for safe operation. Derailments were so frequent that the delivery of cane to the mill was seriously delayed. It so happened that there was a change in the management of the railroad, and some figuring was done which was later verified by actual costs. It was ascertained that the cost of train delays in mill shut-downs and extra wrecking expenses would not only have paid for the labour of putting the track in the proper condition, but would also have paid for improvements that would have required less upkeep costs.

OPERATION.

The American Railway Engineering Association gives an economic rate of speed for a train as 30 kilometres [20 miles] per hour. The rate for cane railroad would probably be between 20 and 30 kilometres an hour. Train resistance varies but little between 10 and 60 kilometres per hour. The tractive power of an engine, when increasing speed from 15 to 30 kilometres per hour, would be reduced about 33 per cent.

Car resistance is generally figured at 6 lbs. per ton. (BYERS gives 3$\frac{3}{10}$ lbs. per ton, with a train velocity of 15 miles per hour, over well surfaced, level track); but light rails, low joints, uneven track, and poor alignment can easily increase the resistance two or three times 6 lbs., which means that the operation of trains can cost three times more than it should cost for this item alone. In working out economic speeds, some railroads fail to consider the saving in equipment investment when giving value to time lost or saved in train speeds.

Assuming the economic speed for a train, over a well-kept road-bed to be 30 kilometres per hour, but, on account of a defective road-bed 33$\frac{1}{3}$ per cent. more tractive power is required, which reduces speed to 15 kilometres per hour, or that the track is unsafe, or the rate set at 15 kilometres per hour, a train would thus consume six hours on a trip of 90 kilometres (not allowing for stops), while if the speed could be increased to 30 kilometres per hour, the trip would require but three hours. If train service required four trips in 12 hours, one train at the rate of 30 kilometres per hour would give the service desired, or two trains at a speed of 15 kilometres per hour. At 15 kilometres per hour, two equipped trains and crews are required, which doubles the cost of operating and the investment.

The above is somewhat overdrawn, as no allowance for terminal delays is made, but it serves to illustrate the point.

Another example: Assuming an engine can pull 30 cars of 20 tons over well-surfaced, level track, train resistance being 6 lbs. per ton, then, over a defective road-bed, with uneven surface, light rails and out of gauge—which increases train resistance to 12 lbs. per ton—the same engine can haul but 15 cars at the same speed. Twice the equipment would be required to haul the same load, thus increasing both the investment in equipment and operating expenses.

It might be well to repeat: A proper road-bed permits of economic train speeds and gives minimum train resistance.

The number of cars required at a sugar Central depends on mill capacity and length of time to load—train operating capacity not being considered if haul is short, nor other factors. The time lost in loading cars is quite an item, as loading takes place in the daytime; some engine time can be made up by night hauling. Time lost loading is naturally greater where the cane arrives at the car loose than where the cutting is done by piecework, requiring that the cane be bundled in the field by the cutter, which facilitates handling and loading of cars. Transferring the cane-rack of a cart, containing the cane, to the car, is also practised, but the time saved is offset by requiring extra cart-racks and a crane at the loading station.

The economic operation of trains is dependent on many factors other than the state of the road-bed. The economy of moving the cane tonnage with as few cars and trains as possible is obvious.

Fuel consumption is an item in good train dispatching that cuts out needless stops and waits, thus also effecting a saving.

Fuel, water, yard, shop and loading facilities have much to do with economic operation and arriving at the minimum cost per ton-mile, which are individual problems for each Central to solve for itself.

Sugar and Alcohol in Peru.

(American Commerce Report.)

The greater part of the sugar-mill machinery in use in Peru including cane carriers, grinders, and centrifugals, is of American manufacture, although some British equipment is found. The Peruvian mills are as a rule not equipped in the most complete and modern manner and make far from the highest possible sugar recovery. The sugar industry suffered heavily in the 1925 season from rain and floods, which, combined with the prevailing low sugar market, have placed this industry in an unsatisfactory condition. In the face of the 1926 outlook for sugar a few planters are turning to cotton, but others may install more efficient equipment to assure the higher sugar recovery necessary if operation is to be continued under present market conditions. Several of the largest mills are owned by American and German capital and are thoroughly equipped with modern machinery.

Alcohol distilling equipment is almost entirely of French manufacture. Until recently the distribution of alcohol was a Government monopoly and, with but a limited local demand, most of the molasses residue from cane grinding was thrown into the irrigation ditches as fertilizing material instead of being manufactured into alcohol. Recently, however, the monopoly has been abolished, legislation has been enacted permitting the use of alcohol for motor fuel, previously prohibited, and an increasing demand for distilling apparatus and alcohol motors may be forthcoming as a result.

Recent Work in Sugar Cane Agriculture.

DISEASE INVESTIGATIONS IN QUEENSLAND. *W. Cottrell-Dormer. Annual Report of the Bureau of Sugar Cane Experiment Stations, 1924-25.*

We are accustomed to hear a great deal about the insect pests in Queensland, and in no cane area has a more thorough investigation being made of them and of the multifarious methods of control. The comparative neglect in the study of cane diseases is the more surprising. Fortunately for the industry, it appears that this neglect is no longer to be allowed to continue ; and it may be surmised that the work of D. S. NORTH, the Pathologist to the Colonel Sugar Refining Company, has been no small factor in effecting this change. His recent paper on "Cane Diseases in Australia" will be in everybody's memory, as a somewhat full discussion appeared recently in these pages.[1] Working in his pathological laboratory at Broadwater, in the New South Wales sugar cane tract, he estimated the damage done by cane diseases in that district at about 9 per cent. of the crop for two successive years; and after a rapid tour through Queensland laid it down that the cane fields there suffered at the least to the extent of 5 per cent. This would equal, in the present year, something near half a million pounds sterling !

It is generally recognized that fungus diseases cannot be wholly mitigated without intensive work by specialists in the laboratory and on individual farms; but a great deal of help can be given by a competent set of officers constantly touring through the districts, making general surveys as to the relative distribution of the diseases, pointing them out to the farmers and giving advice as to the best way of dealing with them. This is the first step in a very long business, and such a beginning was made by the Sugar Bureau in March, 1924, by the setting apart of an assistant entomologist, W. COTTRELL-DORMER, to make a survey of the pests and diseases in the various sugar cane districts. Further, a graduate of Queensland University in Plant Pathology was selected for a study of the cane diseases in overseas sugar cane countries, while two students were set apart for a special study of plant pathology with a view to their employment in the sugar cane work in the near future. This is a good beginning, and appears, on the whole, to be a distinct advance on the old method of drafting into the service a trained mycologist (if such can be obtained) from elsewhere. In no country is it more important that the new officers should be locally trained, and brought up in the vicinity of the small cane farms in which will lie their future work. It is becoming a truism that, without a knowledge of the local conditions and especially the cultivation methods adopted, both entomologists and mycologists are very severely handicapped in any effort to check the losses incurred in the fields. NORTH has emphasized the point that, owing to the unrestricted importation of cane varieties into Australia for many years, practically all the important diseases of the World are already present in the cane fields, while some occur which are not known elsewhere; and one of the first results obtained by the touring officer on a visit to Hawaii, is that *iliau* must be added, a serious cane disease hitherto only reported from this territory.

A preliminary paper by DORMER, after travelling through the sugar cane area for six months, was printed in last year's report by the Director, while the results of a more detailed study, during 1924-5, of the northern and central portions of the tract are given in the report for the year under reference. In the latter paper it is stated that 416 farms had been visited between August, 1924, and September, 1925, and a table is inserted as to the relative prevalence of the chief diseases—gumming, leaf scald, leaf stripe, and mosaic—in these farms.

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[1] *I.S.J.*, 1924, pp. 522-8.

District.	No. of Farms visited.	Gumming.	Leaf Scald.	Leaf Stripe.	Mosaic.
Mossman	44	—	20	18	—
Cairns	85	6	33	—	9
Babinda	55	—	35	—	2
Johnstone River	49	—	15	3	—
Herbert River	70	19	3	—	—
Lower Burdekin	47	—	—	5	2
Proserpine	20	—	—	1	2
Mackay	46	2	—	2	5

In considering this table it must be noted, as the author points out, that the figures should not be taken as a basis for the percentage of infection of any disease in a tract. For instance, mosaic is not at all common in Cairns, but every farm reporting it was at once visited in order to explain to the farmers the best means of preventing its spread. Again, in Lower Burdekin, leaf stripe is only reported from five farms; but here the chief attention was paid to the ravages of the leaf-cutting termites, and these are generally found in farms where stripe is not present.

Interesting information is given, in a series of paragraphs devoted to the separate diseases, as to their local distribution (on the farms visited), and in particular to the effects produced on different varieties of cane grown; only a few of these observations can be repeated here.

Mosaic has at no time been widely distributed over the extreme northern tract (above Townsville); and to all appearance it is gradually decreasing there, because of the persistent ploughing out of all the stools attacked. There is, moreover, a general scarcity of maize, Sorghum and Johnson grass near the cane fields, while the conditions for cane growing are ideal. Further south, secondary infection becomes more frequent, and the carriers mentioned are much more commonly grown, often in close proximity to the cane fields.

Gumming was met with in Cairns, Herbert River and Mackay, and thus from north to south. In Cairns it was found on six adjoining farms, and the infection, although serious, appeared to be quite recent and local. It occurred chiefly on HQ 426, but was also seen on D 1135, R 428, and Badila, besides other varieties. The infection on Badila was slight and was apparently carried on the cane knives at harvest. B 147, Q 813, and H 146 showed great resistance to the disease. In Herbert River it was again HQ 426 which was severely attacked, Badila and others lightly. In Mackay D 1135 was in one place very badly attacked, but other canes generally less severely.

Leaf scald (a bacterial disease) was well distributed over all the districts north of Herbert River, and HQ 426 was again the chief sufferer.

Leaf stripe (downy mildew) is regarded as probably the most difficult disease to control, infection being carried through the air by the extremely minute and light conidia, while the soil becomes infected by the heavier oospores. This disease appears thus to be more serious in ratoons than in plant canes, bad attacks being reported on ratoons of B 147, D 1135, HQ 426, M 1 and fairly bad in a number of others. The oospores may apparently be produced over a considerable period, and as their germination has not as yet been observed, their life history must be worked out before safe rotations can be introduced.

These are at present the chief diseases met with. Shorter notes are given, by **Dormer**, on red rot (all over the tract but only serious in one case), sclerotial disease of leaf and leaf sheath (at least four fungi concerned), root rot (acute Marasmius type causing small losses in all the districts visited), and pineapple disease (serious in one case).

The thoroughness of this work by an "assistant entomologist" almost suggests that a certain amount of pathology is included in the normal outfit of the Queensland entomologist. The author had, however, the cordial assistance of D. S. NORTH, in whose laboratory at Broadwater he spent six weeks of "concentrated study of sugar cane pathology," and he gratefully acknowledges the ungrudging help that he received.

REPORT OF THE PORTO RICO AGRICULTURAL EXPERIMENTAL STATION FOR 1924. *Published at Washington in 1926.*

Considerable attention has been devoted by this station to the introduction and dissemination of new varieties of the sugar cane for combating mosaic. And it is reported that this work has been so appreciated by the local cane growers that they have adopted the unusual course of presenting a cup to the station with the following memorial:—"Whereas the sugar industry in this part of the island was menaced with ruin on account of the mosaic disease, which had invaded its cane fields; whereas the Porto Rico Agricultural Experiment Station, of the United States Department of Agriculture, introduced in 1919 some barrels of cuttings of the Uba cane . . . . which is immune to the disease; whereas from these were propagated the extensive cane fields now existing in all this region, and the industry was thus saved from destruction; resolved, by the undersigned, to present this memorial . . . in testimony of gratitude, and in remembrance of the success achieved." This appears to be a rather unique record, and must be very satisfactory to the Director, D. W. MAY.

In discussing the raising of seedling canes and the introduction of others, it is mentioned that the highest yield in the island, namely, 81 tons of cane to the acre in one case, and 8½ tons of sugar in another, was achieved by the seedling St. Croix 12/4. The rapidity of spreading a new variety has been greatly enhanced by growing the canes for seed purposes for six months only (as in Java and later in India). "A single cutting will produce 10 to 50 canes which mature within the first year; these canes, after six months' growth, will yield from 50 to 250 cuttings, which, cut again in six months, will provide cuttings for a considerable area." This is a useful method if a planter requires to change the variety of cane grown. Small quantities of useful cane varieties are distributed free to the planters by the station for trial, and to induce them thus to grow their own seed from kinds which appear suitable to their special conditions. The climate of Porto Rico appears to be adapted to planting the seed at any time, and a strong case can thus be made out for the starting of seed nurseries which are independent of the period of activity in the factories.

As a result of experiment, it has been found that if magnesium sulphate (in the proportion of 1 lb. to 50 gallons of water) is added to the lime water used in soaking seed cane before planting, the young canes will grow more rapidly and the crop will be greater. The details of the plan of operations are not given, a matter of some importance from what follows below. But the results claimed are of great interest, and are here reproduced. The test included planting the sets as cut, and after soaking in water, in lime water, and in lime water to which the magnesium salt had been added. Germination percentages in the first three were 81·41, 86·42, and 93·03 respectively; besides the action of the chemicals on any borers present, it is considered that they prevent rapid fermentation and conserve the food supply in the sets. At the end of three months the growth made in the four tests amounted to 164 ins., 180, 202 and 220; and the final yields worked out at 58·7, 71·9, 72·5, and 85 tons of cane to the acre.

As to the management of cane soils with regard to nitrogen utilization, a table is presented of a somewhat intricate nature giving the results of varying treatment on 36 plots. It was sought to obtain information from these plots as to the value of liming the soil, incorporating the ratoon residues with the soil, burning this off the ground, green manuring, and the application of ammonium sulphate and nitrate of soda in doses of 30 and 60 lbs. of nitrogen per acre. No remarks are made as to conclusions to be drawn; and, after a careful study of the table, we have been unable to supply this need; although we note that, on the whole, the unlimed plots appear to have given better yields than the limed.

An interesting study is recorded by the horticulturist, T. B. McLELLAND, of the effect of artificial variation in length of day upon the growth of certain plants. This line of study is being taken up a good deal just now, and, if applied to the sugar cane, should give useful data as to the merits of allowing the cane to grow through such long periods as is sometimes done in tropical countries—Hawaii, Cuba, Porto Rico. There is a serious attempt, we believe, in the first-named place to reduce, if possible, the uneconomic holding of the ground by the cane for long periods, including considerable spells when little growth is taking place.

A number of notes are recorded upon varieties under trial and seedlings locally produced, by the assistant horticulturist, J. A. SALDANA. We note that a cane variety named "Java Unknown" yielded, in a comparative test, 55·52 tons of cane to Uba's 49·19; but there are no details of this experiment, although it is to be presumed that the result would not have been published unless proper plot tests were applied. This cane is described as very similar to Uba and its allies, "but can be distinguished from them by its swollen nodes, heavier stooling habit, darker green leaves, and by the ease with which it can be stripped." The latter point is important, and it is desirable that a proper systematic study should be made of this variety. It is quite possible that it is merely yet another variant of the Uba cane, but its supposed origin in Java, together with the greater ease of stripping, awakens a suspicion that it may be one of the POJ series! It is stated that, because of its male sterility, Uba is to be used as a mother in crossing. A few years ago 200 seedlings of an allied form, raised in India by this method, were planted out in plots and tested, but none of them proved superior to the parent; and their general similarity to the female parent awakened the suspicion that actually selfing had taken place. It must be remembered that complete sterility has not been as yet demonstrated in Uba, and that one or two anthers among the many hundreds of flowers in the arrow are capable, in favourable conditions, of fertilizing quite a number of flowers.

REPORT OF THE COMMITTEE ON THE RELATION OF CANE DISEASES TO CANE VARIETIES. *Hawaiian Sugar Planters' Association. H. Atherton Lee.*

In this report the author has put down a series of notes as to the relative effect of different diseases upon the standard canes of the Hawaiian Islands. These notes are largely based on personal observation in different countries visited, but are supplemented by a study of the literature of the subject. Hawaii, the author remarks, is fortunate in having but few of the infectious diseases prevailing in cane growing countries, but some of the standard canes are of wide distribution; so that a considerable amount of knowledge is available, which will be useful in emphasizing the importance of guarding against the entry of these diseases. Such a record is likely to serve a useful purpose in converting all doubters as to the dominant need in the sugar industry for strict quarantine measures. What a world of trouble would have been avoided in cane growing countries if the scientific views on this important matter had been accepted earlier in all countries! This broadcasting of the knowledge, doubtless already collected in the files of all officers dealing with pests and diseases, is an admirable move, and should be followed everywhere: a compact readable statement for the benefit of planters who have little time for the special study needed. The author does not neglect the local diseases, and each standard cane is reviewed as to its behaviour towards these as well, in a somewhat parallel table.

While little is known as to the effect of outside diseases on the Tip canes, which are almost confined to this group of islands, H 109 has been distributed practically everywhere, and a great deal of knowledge has thus been accumulated as to its likes and dislikes, susceptibilities and resistance. The other canes dealt with are Yellow Caledonia, D 1135, Lahaina, Badila, and the Hawaiian form of Uba; and some details are added as to the effect of eye spot (*Helminthosporium sacchari*) on POJ 36, 213, 234 and 979. Lastly, extensive notes, collected by W. W. G. MOIR, on the effect of the last-named disease upon a great number of seedlings raised in the islands, are reproduced, those seedlings which appear likely to be of commercial value being indicated by heavy type.

In considering, from this point of view, the situation with regard to the raising of new seedlings in Hawaii, the author concludes as follows:—"The most immediate need seems to be for a cane equal to the Tip canes in production and in economy of production for mauka conditions on unirrigated lands which will also be resistant to mosaic disease, red stripe, and eye spot; the Tip canes which now occupy these lands are very susceptible to mosaic and red stripe.

"The next need, possibly an equally important need, is a variety for those districts where the climatic conditions favour eye spot; a variety is needed equal to H 109 in production, equally resistant or more resistant than H 109 to mosaic disease and resistant to eye spot. This is rather a large order to fill, but it is not impossible.

"With such varieties and with the maintenance of the islands free from foreign diseases, these islands would be ideally protected from cane diseases."

It is of course not possible to give an adequate summary of the author's summary tables themselves, but the salient features of the effect of the diseases on H 109 are recorded as an illustration of the nature of the information collected. As regards the rest, notes are made which may prove of general interest. In each table the name of the disease, its casual agent if known, and its distribution are given; and two reactions on each cane variety are included, namely, susceptibility to infection, and degree of injury after infection. These two reactions will, in the case of H 109, be mentioned here in succession, and in this order.

H 109.—Of outside diseases, Fiji, gumming, and leaf scald are described as severe, severe; downy mildew (Sclerospora) moderate, slight; smut resistant, resistant; rust (Puccinia) and yellow leaf spot (*Cercospora kopkei*) slight, resistant; and banded sclerotial disease (unnamed fungus with sterile mycelium) moderate, moderate. But, in spite of the wide distribution of this seedling, there are no less than 13 diseases of which unknown, unknown is recorded. We presume that this lack of knowledge is due to the fact that, in spite of its enormous success in Hawaii, it does not appear to have been taken up to any great extent on a commercial scale elsewhere. The effect of local diseases on H 109 is of less general interest; but mosaic and eye spot appear to cause serious damage, pine-apple disease (Thielaviopsis) is rare, but occasionally effects a serious loss in standing canes, and limestone chlorosis and cane yellows cause appreciable damage. Red stripe, iliau, ring spot, Pahala blight, leaf freckle, and sectional chlorosis do little harm, and the seedling is resistant to Lahaina disease.

In Yellow Caledonia the only serious outside diseases appear to be Fiji and curly top, while sereh is also injurious, but to a less extent than in Cheribon. Among local diseases this variety is resistant to mosaic, but if attacked the injury is severe, and it has severe recorded against it for Pahala blight also.—D 1135 suffers severely from Fiji disease, and behaves similarly to Yellow Caledonia with regard to mosaic. The author states that he has observed cases in D 1135 attacked by mosaic, in which the plants have recovered and all symptoms of the disease have disappeared.—Lahaina suffers severely from Fiji disease, gumming and leaf scald, and is also strongly affected by local diseases—mosaic, eye spot (although the injury is only moderate), pine-apple disease in standing canes, two forms of Lahaina disease, Pahalaa blight and limestone chlorosis.—Badila shows some resistance to Fiji disease, and when attacked is more tolerant than other varieties ; it appears to be resistant to other outside diseases but, although resistant to mosaic, suffers severely when attacked.

Lastly, the Hawaiian form of Uba is severely attacked by downy mildew and smut, but is practically untouched by the (comparatively few) other diseases listed. No observation has been made regarding streak.

C. A. B.

Publications Received.

Centrifugal Dryers and Separators. By Eustace A. Alliott, B.Sc., A.M.Inst., M.E. Chemical Engineering Library. (Ernest Benn, Ltd., 8, Bouverie St., London, E.C. 4). 1926. Price: 6s. nett.

This small work has been written from the general viewpoint of the subject, and discusses its principles rather than its practice or its particular applications. Nevertheless, there is a certain amount of matter which will be worth the attention of most sugar factory engineers, such as the main factors affecting time and dryness ; designs of machines proposed for continuous working ; methods applied and suggested for discharging ; and types of separators, as, e.g., may be used in clarification processes. Noticeable is it that, as sometimes occurs, this is by no means a book written for the advertisement of the firm with which the author is connected, makers of other machines receiving very fair mention, indeed as prominently as Manlove Alliott & Co., Ltd. There is a good bibliography appended to the book.

Heat Transfer and Evaporation. By W. L. Badger. (The Chemical Catalog Company, Inc., New York, U.S.A.). 1926. Price: $5.00.

It is explained in the preface that this book was begun with the intention of writing a comprehensive work on heat transfer in all its phases, but that this scheme weakened in the fifth chapter, disappeared in the sixth, and subsequently was abandoned in favour of the subject of evaporators. This prepares the reader for some lack of continuity of plan, and anyway the change of the method of presentation is obvious at the outset of reading. Evaporators are dealt with almost entirely in a general way. known information on the subject being summarized, excepting in chapters 9 and 10, which appear to be written to some extent from the author's own experience and research. These sections deal with considerations such as the conditions affecting heat transfer in evaporation ; hydrostatic head, the steam film coefficient, and liquid film coefficients. A copy of the A. S. M. E. Committee's test code for evaporators, and a fairly full patent list, are appended.

Fifty Years Ago.

From the "Sugar Cane," *May*, 1876.

This number of our predecessor contained articles which mostly were of ephemeral interest only, though from these a few extracts that still may be worth notice may be made.

There appeared an account of the trials made in Louisiana by the Julius Robert Diffusion Company in the year 1875, this consisting in the main of notes from the experimental log book. One set of figures showed the following results obtained by milling and diffusion to be respectively for 1,000,000 of cane worked:—green sugar made (*a*) 72,756 lbs.; (*b*) 10,484 lbs.; cane to produce 1000 lbs. of sugar and molasses (*a*) 13,742 lbs. (*b*) 19,640 lbs.; cost of producing 1000 lbs. of sugar and molasses (*a*) $12·53 (*b*) $15·10; total cost of producing same with cane at $5 per ton (*a*) $46·68 (*b*) $39·20; cost of working up 1,000,000 lbs. of cane (*a*) $911·49 (*b*) $1566·48. Very many difficulties were encountered in the working of this diffusion method, though it was considered to have been proved that the new process was able to produce about 18 per cent. more syrup than was obtained by milling.

G. COMBE STEWART, Chemist at the Cappielow Sugar Refinery, Greenock, gave his methods for determining the water and carbon content of chars, the first being found by drying at 160-180° C., and the latter by the ignition of the dried sample.

In Queensland cane farmers had established the Logan District Cane Growers' Association, and had held a meeting at which the resolution was passed "that it is highly desirable that a Central Mill be erected in this district, and that a sufficient acreage of cane be guaranteed any capitalist undertaking such erection."

J. H. BAYLEY, of Barbados, communicated an article on "Manures: Their Chemical and Mechanical Effects," in the course of which he stated: "In selecting the auxiliary fertilizers, the planter should be guided, not only by the effect produced on the immediate crop as to quantity (although this is his first consideration), but by the influence that certain chemical manures have on the juice of the cane. He ought also to consider in what condition the soil will be left for the production of future crops. Unless he do this, he may find that although he has grown a fine crop to look at, it might be comparitively poor in saccharine matter on the one hand, and on the other he might have inflicted a lasting injury on his fields."

Several patents were given in abstract form, two only of which will here be noticed: WILLIAM B. ESPEUT,[1] of Buff Bay, Jamaica, claimed for a process of making sugar from sugar cane, in which bagasse was reduced to the form of pulp or powder, which was saturated, and expressed, the residue being dried for utilization as paper stock. RICHARD GERVASE ELWES,[2] of Westminster, London, described a char filter, in which the syrup was pumped upwards with a considerable head through the cylindrical vessel filled with granular material.

In this number the use of Fryer's "Concretor" was now being advocated as auxiliary to the vacuum pan. It was claimed that the concretor performed the work of preparatory concentration more rapidly and more economically than the triple effect, concentrating the juice up to about 16 or 18° Bé. on the trays, and to 26 or 28° Bé. on the revolving cylinder, the total time required for so doing being 30 minutes.

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[1] English Patent, 3465.

[2] U.S. Patent. 174,792.

" Sum-Antiscale "

A New Preparation for cleaning Evaporators.

Scale formation on the juice side of evaporator heating tubes is one of the most troublesome problems with which the cane factory executive is confronted. Its prevention being impossible, the question which remains is the quickest and most economical means of removing it from the tubes.

Whether chemical or mechanical treatment is to be adopted depends on the composition and nature of the scale, which is known to vary greatly, differing often in the same factory from season to season.

Generally the method adopted is to boil out the evaporator with caustic soda, or with carbonate of soda, this alkaline treatment being followed by an acid one, using hydrochloric acid. In the case of some scales, boiling with alkali alone will suffice, and in that of others dilute acid will give the desired result.

But, as is very well known, there are some scales, and they occur not infrequently, especially in certain countries, which are quite resistant against such chemical means of attack. Resort then has to be made to mechanical devices, which often are not altogether satisfactory, and anyway require careful supervision if the incrustation is to be removed without undue injury to the tubes.

Such resistant scale is included mostly in the silicate class. Caustic soda, or carbonate of soda, followed by muriatic acid, or the reverse order of treatment leave such scales practically unaffected.

A close study of the problem of attacking silica, and of exchanging bases, has resulted in the preparation of a mixture of chemicals which applied to such scales according to directions is considerably more successful. This mixture is now put on the market under the name of " Sum-antiscale."

Whereas a scale from a sugar factory in British Guiana, consisting very largely of silicate, in a particularly hard form, was found entirely to resist prolonged treatment with alkali and acid under different conditions, it was rendered quite soft in the laboratory by boiling with the new preparation.

After treatment in the factory by this method it is certain that the scale would be rendered sufficiently soft to be removed by brushes, though it is likely that this would be unnecessary, as the scale would probably detach from the tubes due to the action of boiling.

A one-stage treatment only is necessary, acid thus being eliminated, and the mixture has no effect on metals. As the preparation does not cost much more than ordinary alkali, and as acid treatment is no longer required, it is a commercially economical process.

Sugar factory managers are invited to send a small quantity of their evaporator scale to: The Sugar Manufacturers' Supply Co., Ltd., of 2, St. Dunstan's Hill, London, E.C. 3, who will report upon the incrustation, returning same after treatment.

" Sum-antiscale " is believed by those who have examined it to be a valuable method of combating the scale trouble and thus of effecting not a little economy in working, in respect of fuel and labour.

" Kétol " is the name given to a range of solvents recently put on the market in France, made from sawdust or like materials, by the following steps: Fermentation in presence of lime to produce calcium butyrate; dry distillation of this compound; and rectification and fractionation to separate the various ketols having boiling points from 60° C to 200° C. All are excellent solvents, attracting much interest in chemical industry circles.[1]

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[1] Read G. Richoux: *La Revue des Produits chimiques*, March 15th, 1926.

Brevities.

A new fertilizer, claimed to be economical and efficient, containing 20 per cent. of nitrogen, and 15 per cent. of phosphoric acid, is being marketed in Germany under the name of "Leunaphos."

A steam locomotive is being used very effectively at the Tilisay and Bacolod-Murcia centrals, P.I., for killing the weeds along the track by the use of superheated steam, the cost working out at 8 Philippine dollars per kilometre, whereas by hand the cost is about 80 P $ (two weedings at 40 P $).

The New York *World*, drawing attention to the action of the Cuban Government in curtailing the production of sugar for the next two years, points out that this action is in accordance with the advice given that Government by Mr. HOOVER some time ago; and it then pertinently contrasts this advice with the recent hubbub made by HOOVER over a similar restriction on the part of the British Government in connexion with rubber. "Is Cuba right in doing with sugar what Great Britain was wrong in doing for rubber, and if so why?" asks that paper.

At the Bisenz. factory, Czecho-Slovakia, the new pressure evaporator, having three vessels, 700, 800 and 800 sq. m. of h.s., with working temperatures of 126, 118 and 110° C., now concentrates juice from 16 to 70° Brix in 20 mins., whereas formerly in a vacuum apparatus of approximately the same capacity the concentration required about three hours.[1] About 42 kg. of steam per 100 of roots sliced are used, using 5 per cent. of coal of 6500 calories heating value. Far from any discoloration, the juice after concentration is very light in colour, as the result of the unusually vigorous circulation.

In a beet sugar factory in Germany, very good results in respect of the easy removal of incrustation from the evaporator tubes were obtained by allowing a mixture of equal parts of muriatic acid and beet molasses (giving a solution of 2-3° Brix) to remain in contact for a time. This mixture removed the scale as completely as if pure hydrochloric acid had been used, the non-sugars of the molasses apparently exerting some solvent effect upon it.[2]

Dr. N. B. BACH,[3] working in the P.I., has instituted a method by means of which a few cuttings of imported cane can be propagated much more rapidly than by the usual means. A few weeks after the cuttings have been planted, he carefully cuts off the young shoots, trims the leaves, and plants these young shoots as slips. Each young shoot, if carefully tended, develops into a new plant within a few weeks after the first cutting has been planted. Of course, this method involves too much labour for application to large areas, but it is useful for obtaining a rapid start from a few imported points.

G. W. MONIER-WILLIAMS, author of the well-known text book on "Power Alcohol," remarked recently at a meeting of the Farmers' club that in considering the possibility of producing alcohol on a large scale the first difficulty to be faced was the small yield from any given material. Every gallon of alcohol made had to carry the cost of the raw material necessary to produce it, and this is the prime factor in determining whether it can compete with mineral fuels. It would be difficult to produce alcohol from crops in the United Kingdom for much less than 3s. per gallon in bulk at the distillery (fermentation and distilling costs amount only to 5d. or 6d.); and to this had to be added the cost of denaturation, distribution, and all kinds of overhead charges.

Recent work of Prof. KARL PEARSON and Mr. E. S. PEARSON, has shown that the mean values of personal judgment in physical experiments are of an irregular periodic character with respect to time. Dr. J. F. TOCHER, experimenting on the titration of sodium hydroxide with N-sulphuric acid, found that the mean results of successive determinations during a forenoon were also of a periodic character. On an average, the first two determinations were less reliable than the others; the means of succeeding pairs of duplicate determinations also varied in an irregular and periodic manner round the general mean. The variations in the personal equations of observers were independent of the apparatus and the material.

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[1] F. KROZIL, of Maintz, in *Centr. Zuckerind.*, 1926, **34**, No. 10, 223-224.

[2] FR. WILH. MEYER: *Deut. Zuckerind.*, 1926, **60**, No. 8, 197-198.

[3] *Proceedings of the Third Annual Convention of the Philippine Sugar Association, 1925*, page 16.

Review of Current Technical Literature.[1]

Use of Chlorine in the Bleaching of Sugar Juices, Syrups, etc. *Shuichiro Ochi.*[2] *Advance proof of paper communicated to the American Electrochemical Society.*

Not a little interest has been taken in the statements made by this author at a recent meeting of the American Electrochemical Society, held recently in Chicago, in regard to the possibilities of bleaching sugar products by means of chlorine in conjunction with decolorizing carbon. A good number of chemists attracted by the powerful effect obtained with chlorine in the case of most organic substances have attempted to utilize it in the manufacture or refining of sugar, but hitherto unsuccessfully. The trouble appears to have been that, whilst the halogen in its state of aqueous solution and acidity consequent upon its partial hydrolysis in solution to a mixture of hydrochloric and hypochlorous acids, was an excellent bleaching and flocculating agent, and whilst with suitable regulation of the process the chlorine had neither a measurable oxidizing effect nor an appreciable inverting action upon the sucrose, yet the unavoidable excess of free chlorine produced undesirable effects in the subsequent evaporation of the sugar juices. But this Japanese worker and his collaborators, who have carried out investigations on this application to both cane and beet sugar, have now found that if the process be so modified that the juice or syrup, etc., is treated with a small amount of activated charcoal at the stage immediately subsequent to chlorination, all the troubles due to the excess of chlorine are avoided. From the results that have already been obtained it seems probable that the carbon not only catalytically promotes the bleaching action of the chlorine, but that it catalytically converts the excess of chlorine into hydrochloric acid and water, adsorbing and retaining firmly most of the acids that are formed. This process, still under investigation so far as matters such as the yield and the ash content of the sugar are concerned, appears an attractive one, and the sugar industry no less than chlorine producers will follow the investigations with interest.

Methods of Sugar Manufacture in the P.I. *G. H. Haldén and others. Proceedings of the Third Annual Convention of the Philippine Sugar Association, 1925, 61-63.*

Following the reading of papers in this section at the Convention,[3] a discussion took place to which various sugar men contributed, the following being the principal points emerging: Liming after heating had been tried by Mr. Haldén, who found it reduced the amount of scale in the evaporators, though he did not find the procedure to give a brighter clarified juice than is obtained by the usual method. Furthermore, mud instead of scale, resulted in the heaters. Mr. H. Walker said that it seemed definitely established that liming the cold juice to alkalinity to phenolphthalein is the best method of tempering, but this of course demands more tank capacity. Mr. C. Alincastre remarked that his experiments indicated two points of maximum clarity, one on the acid, and the other on the alkaline side, the latter being the brighter. Mr. T. F. Ferraris had tried adding phosphoric acid previous to liming, but had discontinued it, because of the difficult control of clarification that resulted, it being impossible to tell when the right amount of the acid had been used. Mr. Haldén suggested the mixing of lime and phosphoric acid together previously, so as to secure a neutral addition, but the success of this procedure was considered doubtful. Mr. E. W. Kopke said he was strongly in favour of centrifugal clarification for the treatment of the first molasses, there being, in fact, no other practical way of making it clear. Regarding the use of various straining apparatus, the separation of *bagacillo* had great advantages, but one of its disadvantages, Mr. Walker pointed out, was that the mud is much more difficult to filter. In fact, in a factory in the T. H. the cush-cush removed by the strainer had to be put back in the mud to improve its filtering quality.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] Of the Tokyo Imperial Industrial Laboratory.

[3] See *I.S.J.*, 1926, 162.

WAREHOUSING RAW SUGAR IN THE P.I. *Herbert Walker and others.* *Proceedings of the Third Annual Convention of the Philippine Sugar Association, 1925, 52.*

Mr. H. WALKER, speaking on the subject of warehousing in general, said that the ideal method is to install instruments for recording the humidity both inside and outside the building. Then on dry days, when the humidity outside is less than it is inside, the warehouse would be opened; whereas in wet weather the building would be kept closed as tightly as possible to exclude moisture. Mr. F. T. ROSADO had found raw sugar to deteriorate when stored in the same warehouse as fertilizer, and attributed this to a high water content in the latter, which had been taken up by the atmosphere, and passed on to the sugar. Various speakers suggested means of providing a dry surface on which the bags of sugar could be piled. Mr. LABAYEN had found that wood and sawali were less suitable than concrete; and Mr. WALKER stated that anything that will make the concrete floor more water-proof than at present, so as to prevent water coming up through it, is very desirable. Mr. ROSADO stated that filling the bottom layer of bags with rice hulls had given him very good results; while Mr. FERRARIS had found galvanized iron sheets to serve the same purpose. Mr. LABAYEN said he had piled to a height of 35 bags without any undue trouble arising from bursting Sweating was agreed by Mr. FERRARIS not to be due solely to warehouse conditions, but also to the manner of manufacture, one important point being the size of the grain, the larger the better.

EXPERIMENTS ON THE CLARIFICATION OF CANE JUICE. *G. C. Dymond.*[1] *South African Sugar Journal Annual, 1925, 242-249.*

Raw juice contains, in suspension, cush-cush, cane wax and sand, the cush-cush being in hot solution partly soluble, the solubility increasing with continued boiling, and in the presence of lime (as is the common practice with scums). In order to illustrate this, dry washed cush-cush, collected by passing raw mixed juice through a 100 mesh sieve was placed in distilled water and brought to the boil. This liquid was immediately filtered and dried, when it was found to have lost up to 13 per cent of its weight, a filtrate being obtained which was turbid with colloids and very low in purity. On re-boiling, with a 1 per cent. solution of lime, further quantities were dissolved, according to the length of boiling time After each reboiling the filtrate was very turbid, while the filtrability of the cush-cush appreciably decreased. The quantity of cush-cush present in raw juice fluctuates with the quality of the crushing, but from a number of determinations, obtained by passing a given quantity of raw mixed juice through a 100 mesh sieve, 1 gall. was found to contain 0·016 lb. (after drying and washing).

One ton of cane yields, therefore, very nearly 3 lbs. of dry cush-cush, or approximately 6 lbs. of bagasse, which enters the raw juice, passes through the ordinary clarification process, and enters the scum cake. It is accompanied by cane wax, the amount of which per ton of cane was ascertained to be 0·25 lbs. An important peculiarity of cane wax is that on boiling with water for some time, it takes up water of constitution, and turns into a white emulsion, in which state it loses its waxy nature and may easily pass through the filter-cloth. In sugar practice, having once passed the filter-cloth, it shows up in the denser after-products in a viscous disseminated form throughout the media. In fact it is certain that much of the filtering trouble, poor settling, viscosity of the after-products, etc., that cause difficult boiling and curing, unexhausted molasses, and low recoveries are primarily due to viscosity, which viscosity is caused by the presence of cane wax.

It is strongly contended, therefore, that the first principle of raw juice treatment, independent of what subsequent process is used for its further clarification, is the elimination of the maximum amount of cush-cush and cane wax before any heat or chemical treatment is applied. In other countries this is being done so far as cush-cush is concerned by improved mechanical strainers, the cush-cush being sent back on to the mill; and the introduction of the strainers is an essential in the treatment of juice in South Africa.

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[1] Chief Chemist, Zululand Sugar Milling, Ltd., Empangeni.

Review of Current Technical Literature.

Some contend that the presence of cush-cush is a natural filter-aid in the filtration of scums; and in so far as the residual skeleton fibre particles are concerned, this is undoubtedly the case, but the large amount of cane wax which accompanies it, together with the array of other evidence against its retention, must more than balance its beneficial filter-aid properties. Boiling up the scums with lime is one of the worst practices of the industry, resulting, as it does, in the emulsifying of waxes, and the solution of non-sugars these causing a decided increase in the viscosity of the after-products. In attempting to reconstruct the defecation process as at present practised, it is essential to bear in mind the following two points in the art of juice tempering : (*1*) that lime exerts its maximum beneficial effect at a temperature of 50–55°C. (122-131°F.) ; and (*2*) that by throwing out the precipitate of albumens, etc., first, and then using the lime and sulphur precipitate as an enveloping medium (not the reverse), a better action of the lime is secured, and the filterability of the scums is improved. Based on these principles, the following method of conducting the clarification of cane juice is suggested :—Cold raw juice is efficiently strained (the cush-cush and cane wax being returned to the mills), limed just to neutrality, passed successively through a pre-heater and an ordinary juice-heater to raise its temperature to 100°C , cooled by running it on the outside of the pre-heater until it reaches 66°C. (151°F), limed to alkalinity with phenolphthalein as indicator, sulphited, and its reaction adjusted to *pH* 6·8 to 7·0. On no account must the muds be boiled up again, but rather should they be filtered after dilution at a low temperature with the addition of lime and phosphoric acid, if necessary. This method of defecation avoids the errors previously noted, yielding a maximum clarification of the juice, increased filtrability of the scums, minimum losses through fermentation and inversion, together with a reduction in the usual viscosity of the after-products.

Juice Centrifugal Clarification (Mauss Plant) at the Chaka's Fraal Factory, South Africa. Anon. *South African Sugar Journal Annual, 1925, 120-125.*

In this factory (producing about 4000 tons of sugar per season, operated by C. G. Smith & Co , Ltd.) Mauss centrifugals, the construction of which has already been described in these columns,[1] are used successfully for juice clarification, the process in outline being as follows : Juice is sulphured, limed, heated to 205-210°F., and, while the machine is in continuous revolution, allowed to flow into the bottom conical drum and overflows upwards into all the conical drums. Centrifugal force moves the solids and heavier particles through the feeds outwards, towards and against the periphery of the conical drums, leaving a resulting clear liquor flowing upwards and over the top lip of the drums into a suitable launder. A timing gear sets in motion the action of the toggle gear, and the drums are then opened and closed. The feed is automatically cut off before opening, and the solids collected are instantly discharged by centrifugal force at closing, the flow of feed being automatically turned on. Before opening, wash-water may, if desired, be run in to displace all the clear liquor. Solids disharged from the conical drums are received in a stationary outside casing, and fall to a suitable gutter or conveyor. This mud is pumped to the usual scum tank, where it is limed and boiled before passing to the vacuum filters. These consist of a cylindrical drum over which the filter-cloth passes steadily, the drum rotating and causing the mud to collect on the cloth. Clear juice is pumped away and mixed with the centrifugal juice, both going to the feed tank of the triple effects to be concentrated to syrup. By the use of this process it is claimed that the losses are much less than by the use of the ordinary clarification process and no leakages can take place. There are no taps to open, no filter-cloths to remove and wash, and none of the troublesome work of the filter-presses. Mauss machines installed in this factory are capable of handling 2500 galls. per hour, running at 800-1000 revs. per min., belt-driven from a motor, continuously and entirely automatically. Syrup coming from the triple effect is also centrifugalled in a special machine, which thus does away with the customary settling of the syrup in the tanks. One of the great advantages of this process lies in its rapidity and continuity. Juice is not left at rest for a minute from the time it leaves the mill until it emerges from the evaporators as concentrated syrup. Thus the loss caused by inversion and fermentation is reduced to an absolute minimum. From the time the raw juice leaves the mill till it enters the evaporators only 30 mins. elapse. Other advantages are cleanliness; a total reduction of cost; saving of labour, and small mechanical power, about 30 h.p. being quite sufficient to work the whole clarification department of the factory. Furthermore, the saving in heat owing to the entire absence of the settling tanks with their large radiation is considerable.

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[1] *I.S.J.*, 1921, 592 ; 1922, 308.

FACTORS INFLUENCING THE ACTION OF DECOLORIZING CARBON ON SUGAR LIQUORS.[1]

A. A. Blowski and J. H. Bon.[2] *Industrial and Engineering Chemistry, 1926, 18, No. 1, 32-33.*

To obtain an understanding with regard to the "mechanics" of the action of decolorizing carbon on sugar liquors (using a commercial preparation of American manufacture) the following factors were studied with the results here summarized:—*Time.* Adsorption of colour was found to be extremely rapid, the results showing that approximate equilibrium is attained after 15 mins.' contact, and that after one hour no further adsorption takes place. *Temperature.* Between 40 and 100°C. the colour removal is apparently proportional to the temperature, but below 40°C. the colour removal deviates somewhat from the linear function, falling off as the temperature increases. In order, therefore, to obtain the maximum effect the temperature of the liquor should be maintained as high as is possible without causing excessive loss through destruction of sugar by heat. *Concentration.* A higher degree of decolorization is obtained in dilute than in concentrated solution, the amount of carbon per cent. dry substance remaining constant. Above 35° Brix the rate of decrease in colour removal becomes more pronounced, and may be the result of the increased viscosity of the higher density liquors. *Amount.* Adsorption of colour is not a linear function of the amount of carbon used, but appears to follow in general the Freundlich equation,[3] stating that the adsorption per unit weight of adsorbing agent is proportional to a definite power of the colouring matter in solution at equilibrium. *Reaction.* Adjusting the reaction to definite *pH* values, the effect was striking. A change in acidity from *pH* 5·0 to 9·0 causes an increase of colour from 11·4 to 26·3° Stammer per 100°Brix, but this effect is eliminated by calculating the colour removal on the colours of the original and carbon-treated liquors when both were at the same acidity.[4] Satisfactory decolorization can be obtained in neutral or even slightly alkaline solutions within the accepted "safe" alkalinity limit of refinery practice (namely, from about *pH* 6·5 to 7·5). *Quality of Colour.* The major part of the colouring matter of washed raw sugar liquor, probably that part bordering on the colloidal state, is very readily removable by a small percentage of decolorizing carbon. But the removal of the residual colour is a much more difficult problem, requiring increased amounts of carbon. The colour of a highly char-filtered liquor is removed with great difficulty by decolorizing carbon. In a liquor of this nature the char has presumably adsorbed most of the readily removable colour constituents, leaving those less readily removable to be adsorbed by the carbon.

DETERMINATION OF REDUCING SUGARS VOLUMETRICALLY IN THE PRESENCE OF AN EXCESS OF SUCROSE.

N. Schoorl. Archief, 1925, 33, No. 25, 540-543.

Since the procedure lately described[5] is costly if applied on the large scale, owing to the use of 3 grms. of potassium iodide for each determination, it is modified in the following way: After mixing 25 c.c. of the Stanley-Benedict reagent[6] with the assay solution, and with sufficient water to complete the volume to 50 c.c., it is heated as before, and boiled for exactly 5 mins. It is cooled; 0·3 grm. only of potassium iodide (or 1 c.c. of a 30 per cent. solution) added; and 20 c.c. of 25 per cent. hydrochloric acid run in, while shaking round the flask, this being immediately followed by 10 c.c. of 20 per cent. potassium thiocyanate. Subsequently, operations are as already related, the same table being used for the calculation of the result (this being based on the fact that 1 c.c. of thiosulphate solution is equivalent to 3 mgrms. of invert sugar). It is immaterial whether the 0·3 grm. of iodide be added before or after the addition of the hydrochloric acid, and it may even be introduced after the thiocyanate. Kraisy's statement that the reducing power of invert sugar in small amount is increased in the presence of an excess of sucrose (allowance being made for the reduction of this sucrose) is not confirmed by the author.

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[1] *I.S.J.*, 1915, 70, 129.

[2] California and Hawaiian Sugar Refining Corporation, Crockett, Cal.

[3] *I.S.J.*, 1923, 253. [4] Compare, TANNER: *I.S.J.*, 1922, 215. [5] *I.S.J.*, 1926, 165-166.

[6] This should in the previous abstract have been stated to contain 500 grms. of *crystallized* sodium carbonate.

Products of the Oxidation of Dextrose by Copper Reagent. ***F. W. Jenson and F. W. Upson.*** *Journal of the American Chemical Society, 1925, 47, 3019-3024.* One hundred grms. of dextrose oxidized by Soldaini's copper reagent gave 72 of various products, consisting of about 43 per cent. of formic acid, and about 21 per cent. of glycollic acid.—Use of Molasses as Fertilizer in Java. ***J. Kuyper.*** *Archief, 1926, 34, No. 4, 95-98.* Question is raised whether estates should sell their molasses to the Pure Cane Molasses Co., Ltd., for exportation to England, or whether it is advantageous to use it (or some of it) as manure. It is shown that on certain types of heavy clay soil of bad quality the addition of molasses exerts a favourable effect, but further data are required to elicit the reason for this.—New Method for Sulphitation Factories in Java. ***Ph. van Harreveld.*** *Archief, 1925, 33, No, 21, 439-440.* H. Egter proposes that after liming the raw juice as usual it be filtered through bagasse, then the clear juice submitted to the usual sulphitation procedure, using filter-presses for the mud separation. A better white sugar with less sulphur consumption is expected.—Carbon Filtration of Thick-Juice (Syrup). ***V. Sazavsky.*** *Zeitsch. Czecho-Slov., 1925, 49, 487-489.* Filtration of the evaporator syrup in a beet factory gave brilliant and colourless liquors, which remained clear later in the pans, or but slightly dim, whereas untreated syrups were strongly clouded. Crystallization moreover, was definitely easier. Figures are given to show that the use of "Carboraffin" in this way is economical without considering better sugar made.—Apparatus for Dry Liming. ***Berthold Block.*** *Deutsche Zuckerindustrie, 1925, 51, 117* A description (with illustration) is given of an apparatus for dry liming in white sugar manufacture at the Dinteloord beet factory, Holland, this consisting of a cage containing the lime, given an up-and-down motion inside the juice liming tank, which is fitted with a stirrer. Liming is done at 80°C., and 1·8 per cent. of the roots is added.—Hydration of Carbon. ***F. J. Nellersteyn.*** *Chemisch Weekblad, 1925, 22, 565-571.* Finely divided carbon (e.g., activated carbon) when treated with permanganate is oxidized to CO_2, with the formation of a mixture of acids, aromatic in the case of "Norit," and aliphatic in that of "Carboraffin" Such polyoxy acids being allied to carbohydrates, the author believes that these facts support Willstätter's theory of the synthesis of sugar by plants.—Loss of Weight of Beets after Dumping. ***Anon.*** *Sugar Press* (of Denver, U.S.A.), *1925, 9, No. 3, 13.* A ton (2000 lbs.) of roots, showing 16 per cent. sucrose when dumped, may only weigh 1880 lbs. with 15·6 per cent. of sucrose before it enters the factory.—Shaking Gutters. ***H. C. Lohr.*** *Archief, 1925, 33, No. 45, 1224-1227.* Directions are given for the construction of shaking gutters for sugar, mounted on springs.—Laboratory Cane Milling compared with Factory Results. ***W. E. Cross.*** *Revista Industrial de Tucuman, 1925, 15, 160-164.* Portions of cane (200 kg. each) were ground repeatedly in a laboratory mill, and gave the following figures.

Number of Grindings.	Extraction.	Sugar Content of Juice, per cent.	Purity.
1	46	17·40	84·36
2	53	17·47	83·65
3	56	17·47	82 65
4	58	17·52	82·87
5	60	17·52	81·16

An extraction of 60 obtained after five grindings in the laboratory shows just about the same extraction and juice purity as is obtained from the first unit of a factory mill.

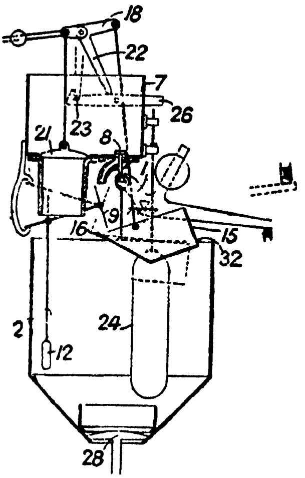
J. P. O.

Review of Recent Patents.[1]

UNITED KINDGOM.

WEIGHING APPARATUS.* *B. Boulogne*, of Pasoeroean, Java. *247,158.* January 2nd, 1926; convention date, February 6th, 1925.

An automatic liquid-weigher is provided with an auxiliary container which, when filled by liquid passing through the dribble feed valve, is adapted to open the main-feed valve. As shown, a weighing tank *2*, suspended from a weigh-beam *1*, is filled from a feed-hopper *7* through a main valve *21* and dribble valve *8*. An auxiliary container *15* pivoted at one end *16* is disposed beneath the dribble valve *8* and is connected through a lever *18* to the main valve *21*. At the commencement of the filling operation, liquid flows through the valve *8* into the container *15*, which eventually overbalances, opens the valve *21* and discharges through an opening *32* into the tank *2*. The valve *21* is held in open position by the engagement of an arm *22* on the lever *18* with a notch *23* in a lever *26*. As the liquid rises in the tank, a float *12* lifts and tilts a screen *9* to divert the flow from the valve *8* directly into the tank *2* When the tank is nearly full a second float *24* rises and trips the lever *26*, thus allowing the valve *21* to close. The tank finally overbalances the weigh-beam *1* thus allowing the valve *8* to close and causing the discharge valve *28* to open.



PROCESS OF WHITE OR REFINED FROM RAW SUGAR.* *A. W. Mathys* (communicated by *F. Kessler*, of Belgrano, San Fernando, Argentina). *246,976.* December 23rd, 1924.

White or refined sugar is produced from raws by subjecting the raw sugar to a sudden change of temperature; for example, by the sudden introduction of superheated steam in large volumes, so that the sugar crystals are cracked or broken into fragments while conserving their crystalline structure, the crystals being then treated with a pure sugar solution, or a sugar solution containing refining agents such as hydrogen peroxide or sodium hydrosulphite. A concentrated clear sugar solution is used, and may be obtained by adding water to the crystals to dissolve sufficient to form the required solution, or it may consist of purified syrup from a previous refinement. The crystals may be treated with the solution on the counter-current principle, or by dialysis, diffusion, osmosis, or other method. By this treatment the impure mother liquor in the crystals is removed, or is refined by the refining agents. Where steam is employed for the cracking, etc., the refining agents may first be added to the crystals, and will during the steam treatment be dissolved together with sufficient of the crystal mass to form the required solution. The mass obtained may be centrifuged to separate the syrup, which contains the refining agents, and then dried to give a granulated sugar which may be pressed or stamped into cakes or strips, or solid slabs may be produced by thorough spinning and drying in the centrifugal machine. Syrup separated may be employed in treating the next batch of sugar. Alternatively, the mixture of crystals and syrup may be treated in crystallizers so as to increase the size of the crystals or partially to reunite the crystal fragments. Where high grade refined sugar is desired, the crystals may be treated several times in crystallizers, a purer syrup being employed each time, and different refining and decolorizing agents may be used. Where a battery of crystallizers arranged for continuous working is used for this treatment, the sugar syrups employed may be used repeatedly.

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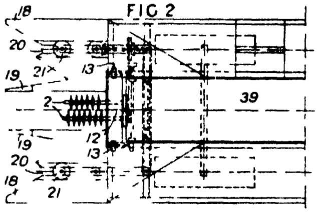
[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. 2 (price 1s. each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each), *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin, Germany.

CANE HARVESTING MACHINES.* ***J. J. M. Elias,*** of Banjoemas, Java. (*A*) *209,596.* January 2nd, 1923. (*B*) *246,045*; addition to *209,596*, July 31st, 1925.

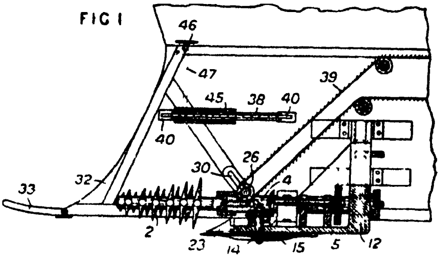
(*A*) A motor-driven machine for mowing and harvesting sugar cane plants is adapted to jerk up the roots from the ground by means of a set of rotating longitudinally-arranged shafts *2* provided with teeth, and behind these shafts is arranged a conveyor band *39*. The shafts are driven in opposite directions by gearing from the motor, and are supported in bearings *12* vertically adjustable by means of toothed wheels *13* and rack gearing. To prevent the cane stalks from falling sideways during harvesting, the front of the carriage has bent plates *18* provided with interchangeable pointed members *19*. These members direct the fallen cane stalks along the plates *18* to grooves *20* provided with rotating cutters *21* for severing the canes. The inclined plates *18* extend over the whole length of the machine and constitute a gutter, the bottom of which is formed by the conveyor belt *39* moving over supporting rollers. The conveyor is driven from the rear axle of the machine, and is arranged to run first horizontally and then in a downward direction at the rear.

FIC 2



Patent, 209,596

FIC I



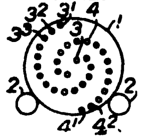
Patent, 246,045.

(*B*) In order that the machine described in the parent Specification (above) may be used for mowing canes when the root-stocks are not to be uprooted, the two toothed uprooting-shafts *2* are removably mounted on an adjustable slide *12* provided with means for supporting and driving a disc saw *15*. The shafts *2* are removably coupled to two shafts *4* driven by chain gearing. The slide *12* is adjustable vertically in dovetailed grooves by racks and pinions. The shaft *14* of the disc saw *15* is mounted in the horizontal part *5* of the slide *12* and is driven by spur-and-bevel gearing from one of the shafts *4*. The part *5* is triangular in front and carries a removable double plough-iron *23*. The cut canes fall on a conveying-band *39* provided with rows of bent pins. The band *39* passes round a roller *26* resting on the shafts *4* and mounted on a spindle passing through arc-shaped guide slots *30* in the side catch-plates *32*, which are provided with shoes *33* adapted to turn upwardly only Two side gripper-chains *38* carrying prongs *40* are provided to engage the canes. They pass through slots in the plates *32* and are guided by flanged discs and channel-shaped guides *45* provided with vertical rollers. They are driven by the shafts *47* of disc saws *46* rotating in the horizontal slots of the plates *32*. Roller discs may be rotatably mounted on the ends of the prongs *40*.

MASSECUITE CRYSTALLIZING APPARATUS.* ***F. Lafeuille,*** of Paris. *245,114*. December 18th, 1925; convention date, December 24th, 1924.

In an horizontal rotary cylindrical chamber for crystallizing massecuite fitted with longitudinal tubes for circulation of cooling water, the circulation is arranged so as to obtain uniform cooling. In a vat *1* carried on rollers *2* and containing cooling tubes *3*, *4* arranged in spiral form, instead of supplying cold water to the outer tubes 3^1, 4^1 of the spirals and withdrawing it from the inner tubes, the water is supplied to the outer tube of one spiral, and to the inner tube of the other spiral, and the supply and withdrawal pipes are provided with cocks to reverse the circulation. Alternatively all the tubes of one spiral may be fitted to one inlet header and one end of the vat and to an outlet header at the other end. A device is provided for regulating the temperature of the water at the inlet consisting of a means for mixing hot and cold water or of a steam heater. Where water is available only in small quantities, a refrigerating device operated by carbon dioxide, ammonia, etc., may be used for cooling. The spiral arrangement of the cooling tubes may be replaced by an arrangement of the tubes in bundles communicating with radial headers so that in all circular paths round the axis of the chamber the degree of cooling is approximately the same. A diluting liquid may be added to the contents of the chamber through a tube on the axis of the chamber.

FIG.2.



CENTRIFUGAL MACHINE.* *L. Salcines,* of Guantanamo, Cuba. *248,022.* September 26th, 1924.

A centrifugal separator has a feeding chamber, the entry of the material to the basket being controlled by the pressure of the material in the chamber. As is shown, the separator has an inner imperforate drum *A* and an outer perforated drum *B* in a fixed casing *C*. These drums are arranged to rotate at different speeds and the drum *A* carries a helical rib *4* which contains a number of plunger scrapers *3*. Each scraper is connected to a piston *37*, Fig. 3, and is normally withdrawn from the drum *B* by a spring *36*. The scrapers are moved into the operating position shown in Fig. 3 by compressed air, which is supplied to the channel *32* through the regulator *R*¹, Fig. 2, chest *26*, and central tube *24*. Steam is used to clear the drum of the thin layer of material left by the scrapers and is supplied to outlet tubes *2* in the rib *4* through the regulator *R*, chest *27*, and tube *23*. Brushes *47* are also provided on the rim. Liquid passes through the drum *B* and is collected by the trough *63*, while the solids pass through the gap *38* into discharge conduits *39*, which may be closed by gates *45*, *46*. A door is arranged in the wall of the drum *B* and another *21*, Fig. 1, is arranged in the casing *C*. A chamber *P* is arranged at the top of the casing, and it opens on to the top of the inner drum *A*. The top of the chamber may be closed by doors *42*, *43* on a hinge *44*. Pistons *5*, *6* are arranged in cylinders in the wall of the chamber and are held level with the wall, as shown in Fig. 11, by springs *7*, *8*. Each piston carries a contact which can touch a fixed contact to complete the circuit of an electromagnet *13*. This operates its core to close the valve. When the machine starts, the valve *N* is opened manually and material passed from the trough *S* to the chamber *P*, and the space between the drums *A*, *B*. If the pressure in the chamber *P* rises sufficiently, the pistons *5*, *6* operate to close the circuit of the electro-magnet, which closes the valve *N*, and stops the flow of material.

FIG.1.

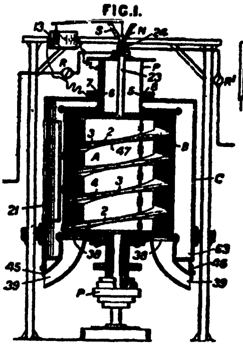


FIG.2.

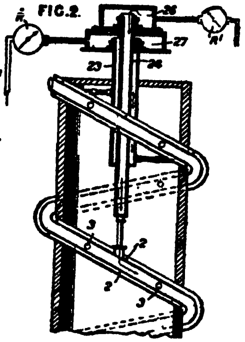


FIG.3.

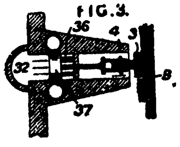


FIG.11.

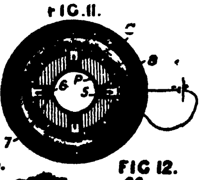


FIG.5.

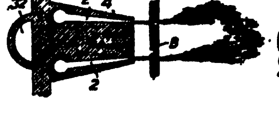


FIG 12.

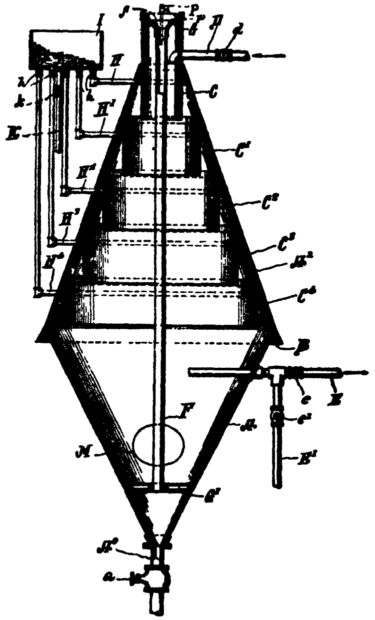
CONFECTIONERY. (*A*) *H. E. Martin*, of Gainsborough, Lincs. *246,546*. October 28th, 1924. (*B*) *A. H. Scrase*, of Croydon, Surrey. *246,576*. October 29th, 1924. (*C*) *A. Fritz*, of Dresden, Germany. *247,046*. May 6th, 1925. (*D*) *G. Poverud*, of Norwich. *247,063*. June 8th, 1925. (*E*) *Aktiebolaget K. Fazer O. Y.*, of Helsingsfors, Finland. *247,135*. April 3rd, 1925. (*F*) *Peek, Frean & Co., Ltd., and L. Rondonin*. *247,388*. February 14th, 1925.

(*A*) Relates to improvements in the final folding operations of a wrapping machine for caramels, etc., of the kind described in Specification 203,370, each article being dealt with in the previous manner until it is wrapped on four sides. (*B*) Confectionery, carried through the machine trays by an endless chain, is cut up into strips or squares by knives which can be rotated at different speeds by gearing to suit different materials. (*C*) A machine for drilling, filling, sealing and delivering hollow confectionery bodies, comprises a turntable carrying equally spaced circularly arranged holders for the hollow bodies, a vertical slide having brackets which carry the drilling, filling and sealing means respectively, and a delivery device which transfers the confections from the holders to an endless conveyor. (*D*) A "piping" machine for forming and decorating sweetmeats, of the type wherein the plastic material is mixed in a hopper and is passed under pressure to a flexible extrusion bag, is characterized by the forcing-means being directly connected to the mixer. (*E*) Relates to a machine for wrapping in two wrappers sweetmeats and other objects which may vary in size. (*F*) Relates to a process for coating biscuits and the like by "flooding" in which the product is formed with ridges to simulate confections produced by dipping in skeleton frames.

MANUFACTURE OF COMPOUND YEAST NUTRIENT. *H. W. Dahlberg*, of Denver, Colo., U.S.A. *246,002*. May 20th, 1925. A nutrient solution for yeast (containing ammonium phosphate, etc.) is enriched in organic nitrogen by the addition of waste waters resulting from the desaccharification of beet molasses.—STARCH GLUCOSE (DEXTROSE) MANUFACTURE. *Corn Products Refining Co.*, of New York, U.S.A. *246,098*. August 11th, 1925. Crystalline glucose is prepared from starch-converted glucose by bringing about supersaturation in a solution of such high purity that crystallization starts substantially as soon as supersaturation takes place.—SUGAR PRODUCT MADE WITH YEAST. *R. Willstatter*, of Munich, Germany. *246,109*. November 26th, 1925; convention date, January 16th, 1925. Yeast is mixed with at least one-third of its weight of sugar, and the mixture heated to about 100°C., preferably slowly and in stages, to produce a homogeneous product, which may be made into jelly or sweets, or may be used in brewing, or as a medicine, or as an ingredient of bread, cakes, etc. Maltose in the form of its extract may be used — EVAPORATOR WITH PROVISION FOR COMPRESSING EXHAUST STEAM. *L. de Latour*, of Wellington, N.Z. *246,807*. December 10th, 1925. In an evaporator (for brine, etc.) the liquid goes via a preliminary heater through five effects, each of which is fitted with a compressor. FILTER WITH TRAVELLING BAND CLOTH. *J. A. Hudspith*, of Brampton, Cumberland. *246,946*. November 22nd, 1924. A filter presumably of small type is described, in which the cloth is adapted to be drawn by rollers so as to renew the filtering surface.—PRODUCTION OF METHYL ALCOHOL. *G. Patart*, of Paris. *247,932*. January 28th, 1926; convention date, February 23rd, 1925. *247,176*. January 28th, 1926; convention date, February 7th, 1925. A mixture of water gas of normal composition with gases from the distillation of coal and like fuel, when passed over a catalyst adapted to form methyl alcohol from carbon monoxide and hydrogen, yields a product consisting of methyl alcohol and liquid hydrocarbons.—PREVENTION CORROSION, ELECTRICALLY. *A. S. and M. C. Gush*, of Hove, Sussex. *247,195*. February 3rd, 1926; convention date, February 3rd, 1925. In an electrolytic system for preventing corrosion in condensers, tanks, etc., anodes in the form of iron rods are secured to bars which are carried by insulated bolts connected to a source of current.

UNITED STATES.

SUBSIDING TANK, FOR CANE JUICE CLARIFICATION. *Benno Sandmann*, of New Orleans, La., U.S.A. *1,557,340*. October 13th, 1925.



It comprises an outer shell or casing, preferably in the form of two frustums of cones A and A^1, joined together at their bases. At the joint, a supporting ring B may be placed to support the apparatus upon some support. The bottom of the shell or casing is provided with a drain pipe A^0, controlled by the valve a. The top of the casing is open. Down through this open top projects the cylinder C, which is open at both ends. Mounted in the conical portion A^1 of the casing, below and exterior to the cylinder C, are a number of short cylinders C^1, C^2, C^3, and C^4, each cylinder being open at top and bottom, but the upper ends of the various cylinders C, C^1, C^2, C^3, and C^4, being secured to the wall of the casing to form a tight joint, beneath which joint is an annular chamber in the form of an inverted V in the cross section, into which the clear liquid will tend to rise. D represents a supply pipe for conveying the raw or treated juice to the casing, the flow through which may be controlled by the valve d. E is a pipe for drawing off the liquid from the upper portion of the cone shaped chamber A, the flow through which may be controlled by the valve e. This would be used for drawing off periodically. This pipe may also be used to wash out the system, being provided with a branch pipe E^1 controlled by the valve e^1 connected to a source of hot or cold water. F is a drain pipe which extends axially through the casing, and near the top thereof terminates in a funnel f, its purpose being to carry off the scum and foam that rises to the top of the apparatus. This pipe F may be held in place as by straps G, and spider G^1. H, H^1, H^2, H^3 and H^4 represent pipes connected to the upper portion of the inverted V-shaped annular chambers surrounding the corresponding cylinders C to C^4. These pipes, H to H^4, have their outer ends opening into the tank I, from which the clear liquid may be drawn by the pipe K, having a valve k. The flow of liquid through each of the pipes H to H^4 may be controlled by a valve h, one being provided for each pipe. Details of operating the tank are as follows:—

Assuming the apparatus to be completely empty, and the pipe D connected to the source of liquid supply, close the valves e and a, and open the valves d, h and k, permitting the liquid to flow in through the pipe D. Following this, it will be observed that as this liquid rises in the casing, the heavier solid particles will tend to settle in the bottom of the chamber A and the clear liquid will tend to rise into the upper portions of the inverted V-shaped annular chambers surrounding the various cylinders C^4 to C. As the liquid rises in the casing, the scum and froth will accumulate in the centre thereof, and overflowing in the cylinder will pass into funnel f. The clear liquid will escape through the pipes H^4 to H, respectively, and will flow into the clear liquid tank I, whence it will be carried off through the pipe K. Should it be desirable to control the flow of clear liquid through any one of the pipes H^4 to H, this may be done by manipulating one of the valves h. Thus, for instance, if the liquid is running muddy from the pipe H^4, the corresponding valve may be closed, or partly closed, permitting only the clear liquid from the pipes above to escape into the tank I. In the same way, the flow of clear liquid through the other pipes may be varied at will. While operating continuously from time to time, the accumulation of mud may be withdrawn from the chamber A through the drain pipe A^0. If desired, this valve a may be kept partly or wholly open, and a continuous flow of mud with foul liquid may escape past the same. The foul liquid may be pumped or otherwise conveyed from the pipe A to any desired place.

MANUFACTURE OF COMPOUND YEAST NUTRIENTS. *Robt. L. Corby and Ruth Glasgow* (assignors to *The Fleischmann Company*, of Ohio, U.S.A.). *1,571,932.* February 9th, 1926. Consists of molasses, cereal material, and yeast nourishing salts with a compound containing inorganic nitrogen, applied in a particular manner here specified.—HOLDER FOR BEET TOPPERS' KNIVES. *Wm. Hogan*, of Fillmore, Utah, U.S.A. *1,572,289.* February 9th, 1926. In combination with a lifting element and the handle therefor, a sling, a hook carried by the sling, a strand of wire clamped back upon itself and extending around the lifting element adjacent the handle, the free ends of the wire having loops formed therein, said looped ends overlapping each other and registering to receive said hook.—CANE HARVESTER. *John A. Paine*, of Richmond, Va., U.S.A. *1,572,410.* February 9th, 1926. Claim is made in a cane harvesting machine for the combination of two endless chains having adjacent parallel runs, and cane grippers carried by said chains and spaced apart to cause the grippers on the opposite chains to mesh with each other and to grasp stalks of cane between them while they travel along said parallel runs, said grippers being constructed to hold said stalks in an inclined position.—USE OF GLUCOSE FOR DE-INKING PAPER. *Grant Hammond*, of New Haven, Conn., U.S.A. *1,572,479.* February 9th, 1926. Claim is made for a composition for de-inking paper, including a saponaceous ingredient and an ingredient of the glucose series, all combined with water. —THICKENING PROCESS *A. L. Genter*, of Salt Lake City, Utah, U.S.A. *1,575,907.* March 9th, 1926. Claim is made for the process of filtering and thickening a mixture which comprises subjecting the mixture while in contact with a filtering medium.—EXTRACTION OF JUICE *Walter Raabe*, of Cothen, Germany. *1,575,936.* March 9th, 1926. Claim is made for a multichamber leaching apparatus for solid and semi-solid material, and more particularly for removing sugar from sacchariferous plant cuttings on the counter-current principle.—CONVERTING DEXTROSE INTO LOAF OR BLOCK FORM. *Raymond E. Daly*, of Homewood, Ill., U.S.A. *1,575,975.* March 9th, 1926. Granular dextrose containing 12–14 per cent. of water is subjected to pressure in a mould, and the resulting mass cut to the requisite size.—INCRUSTATION PREVENTION, ELECTRICALLY. *Guy H. Elmore and Henry J. Creighton*, of Swarthmore, Pa., U.S.A. *1,576,581.* March 16th, 1926. Claim is made for the process of protecting a surface of a metallic body against encrustation or scaling which comprises passing an electric current through the body and maintaining throughout the body of which the surface is to be protected a potential gradient below that which will accelerate normal electrolytic corrosion thereof while maintaining a cross sectional density of current in the body whereby encrustation and scaling of the surface will be eliminated.—PURIFICATION OF SYRUPS, ETC [1] *K. Urban*, of Pecky, Czecho-Slovakia. *1,577,389.* March 16th, 1926. Claim is made for a process of purifying a sugar solution by means of a compound which has the property of exchanging alkaline earths for the alkalis of the sugar solution, characterized by the fact that the sugar solution is filtered through said compound until a maximum enriching of the sugar solution with alkaline earths is obtained, and is then further filtered through a compound having said exchange property to remove alkaline earths and other ashy substances and organic non-sugar substances to a large extent from the solution.—DISINTEGRATOR FOR SUGAR. *Wm. E. Prescott* (assignor to *Baker-Perkins Company* Inc., of New York). *1,577,492.* March 23rd, 1926. Claim is made in a disintegrator for the combination of a casing comprising relatively movable sections hinged together about a longitudinal axis, a feed hopper carried by one of said sections, means whereby the sections may be detached one from the other, a series of interior baffles carried by said casing sections and comprising separate elements each pertaining to the respective sections, rotary beaters mounted within the casing between the aforesaid baffles, a discharge outlet carried by another of said casing sections, means whereby said latter section can be rotated about the axis of the beaters, means whereby said last mentioned casing section can be held in various positions of rotation.

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[1] See U.K. Patent, 389,810 ; *I.S.J.*, 1924, 454.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1926. Tons.	1925. Tons
Total Receipts, January 1st to April 29th	1,268,632	1,302,104
Deliveries ,, ,,	1,126,433	1,222,955
Meltings by Refiners ,, ,,	1,045,000	1,151,530
Exports of Refined ,, ,,	35,000	56,452
Importers' Stocks, April 29th	150,855	79,149
Total Stocks, April 29th	302,566	172,531
	1925.	1924.
Total Consumption for twelve months	5,510,060	4,854,479

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924 Tons	1925 Tons	1926 Tons
Exports	1,455,575	1,563,873	1,323,976
Stocks	660,388	802,936	1,193,158
	2,115,963	2,366,809	2,517,134
Local Consumption	30,000	45,000	35,000
Receipts at Ports to March 31st	2,145,963	2,411,809	2,552,134

Havana, March 31st, 1926 J. GUMA.—L. MEJER

Sugar Crops of the World.

(Willett & Gray's Estimates to April 29th, 1926.)

	1925-26. Tons	1924-25 Tons	1923-24. Tons.
CANE.			
America	9,129,112	8,875,783	7,419,141
Asia	6,125,360	5,565,390	5,909,840
Australasia	612,344	536,490	345,757
Africa	663,985	575,342	572,022
Europe	9,000	8,087	7,871
Total Cane	16,539,801	15,561,092	14,254,631
BEET.			
Europe	7,455,903	7,077,791	5,057,761
U.S.A.	804,439	974,185	787,217
Canada	32,475	36,200	16,500
Total Beet	8,292,817	8,088,176	5,861,478
TOTAL CANE AND BEET..	**24,832,618**	**23,649,268**	**20,116,109**

THE
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☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 330. JUNE, 1926. Vol. XXVIII.

Notes and Comments.

The Strike and its Aftermath.

As we were able to record in our last issue, the general strike of coalminers, transport men, and certain other industries (including the printers) which held up this country for nine days in May collapsed very suddenly and much sooner than some folk had anticipated. It was made clear to the instigators that the resources of the State and the adaptiveness of modern youth (and we might add middle age) to unaccustomed tasks were more than equal to combating the attempt to hold the country to ransom. There was a day when the cessation of railway services would have paralysed the country; but the widespread use of mechanical transport and the ability of amateur drivers of even small pleasure cars to handle big commercial motor units has changed the situation, and every railway strike only educates industry further in the advantages of road carriage to the detriment of the railway interests. The lesson is now to all appearance being assimilated by the trade unions concerned, and it seems very unlikely that any more cases of sympathetic strikes will be allowed by the transport workers; they will need a big grievance of their own to bring them out.

Although the strike collapsed with unexpected suddenness, the wheels of industry did not start revolving smoothly for some ten days or a fortnight later, owing to the fact that the employers rightly refused to take every striker back regardless of the amount of work that was available for them. This led to a temporary continuance of trouble, and in some cases it was another week ere the printers returned to work. For this reason our issue of May was delayed some ten days, or a greater belatedness than we encountered with any issue during the great war! But the lesson has been learnt—which is that strikes seldom pay, least of all when they are attempts to hold up the country and not merely to settle a genuine trade dispute between employers and their workers—so the greater or lesser inconveniences suffered by industry have had their compensations. Moreover, the principles at stake were not merely local ones, since the whole industrial world was watching the outcome of the big tussle between labour and the country, and had the former succeeded in their desperate attempt to overcome constitutional Government, the example would have been followed sooner or later in other countries. Contrariwise, the defeat of the attempt has given to the whole world a convincing proof of the futility of such proceedings.

But while we weathered the general strike successfully, it must not be overlooked that the coal strike was not settled thereby, and the coal problem is proving a very thorny one. Private sympathy for the miners is widespread; but it is recognized that they are being badly advised by their leaders, who are obstinately ignoring the economic factors concerned and refusing either to accept a cent less pay or work a minute a day longer. This "never never" policy will not help them to find and retain overseas markets for their coal, and the British miner depends chiefly on the export trade for the wealth accruing to his industry. At the time of writing the mines have been idle for six weeks, and no settlement appears yet in sight. Meantime industry is being slowly brought to a standstill, as stocks of coal are reduced to a minimum. But much as the country desires a speedy outcome of the dispute, it is realized that any patching up of the points at issue without regard to the economic question whether coal is going to be produced at a competitive selling price, will not be of any permanent benefit and will only put off the evil day, in the meantime manacling trade generally in its attempt to revive and develop its markets. So, much as the country is losing by the strike, it seems better to lose now once for all than have continual losses at intervals in the next few years. A coal truce for five years is the thing most needed, and any drastic means to secure it should not be avoided.

It may be added that the coal strike has affected the sugar refining industry in this country like other industries using that fuel. All the Clyde refineries but one have had to cease work, while the Thames refineries are working with difficulty and, we believe, are using oil fuel where possible. The sugar-using industries are, needless to say, also seriously affected by lack of their usual supplies of fuel.

The Cuban Crop Reduction Law.

The details of the Cuban Crop Reduction Law as passed by the Cuban Congress have now been made public. The gist of the new regulations is as follows[1]: Grinding at the sugar mills during the next two seasons (1926-27 and 1927-28) is not to start till dates decided on by the Executive (which are generally expected to be the 1st of January each year); a penalty of $5 for each sack of sugar manufactured before that date will be exacted. A temporary production tax of $5 per sack of sugar is to be levied on all sugar produced which exceeds 90 per cent. of the crop estimated for each sugar mill during the year 1925, and the Executive will reserve the right to exact the same tax in either or both of the following seasons if thought necessary. The 90 per cent. crop quota is to be applied also to the colonos, and only the proportional amount of each colono's cane is to be ground by the mills concerned, as is also the mill's own cane. The quota of each mill is to be decided by the Executive, who will average the three leading estimates of the crop (Guma, Himely, and the Secretary for Agriculture) for the purpose of arriving at the figure. The succeeding yearly quotas will be fixed by a technical body under the direction of the Executive. Provision is made in the case of several mills under one ownership, that where drought, fires or other circumstances prevent one of the mills completing its 90 per cent., the deficiency can be made up in any other of the mills of that ownership.

Some of the mills this season have already exceeded their quota, but providing they ceased grinding within three days of the enactment of this new law, they are not to be subjected to any penalty. The 1925-26 crop is to be limited by the law to 4,758,993 long tons, but it is expected that owing to prior production in excess of the quota, the total will be more like 4,900,000 tons. According to LAMBORN, the effect of the grinding season being delayed till January means that the Cuban crop of this year must last till well into January next year; in the past season as much as 250,000 tons was produced prior to January 1st, so it is obvious that the old supply will have some four or five weeks longer wherein to be absorbed before the new crop sugars enter the market. This will tend to have a bullish effect on the market during the next six months.

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[1] We are indebted to Messrs. Willett & Gray's full translation of the Cuban document, from which to derive our summary.

The Cuban Crop Limitation and its Effect on World Production.

The situation brought about by this legal restriction of Cuban production was summed up in detail by the Czarnikow-Rionda Company in their Weekly Report of May 7th last. We take from it the following excerpts:—

"The main object is to stabilize sugar prices at a reasonable level in order that the Cuban producer may obtain a fair profit. This stabilization will benefit the American beet producer as well as Louisiana and Porto Rico, the Philippines and Hawaii. While this measure will advance the price of the refined article, the American consumer should bear in mind that he is buying the largest percentage of his requirements from Cuba at a price below the cost of production, and consequently he should not resent Cuba's endeavour to protect her industry. Besides, extremely low prices for any article invariably lead, sooner or later, to curtailing of crops, increased consumption and consequently extremely high prices.

"President MACHADO could have chosen no better time for the introduction of this legislation, because it is now too late to increase the beet sowings in Europe or the United States. Therefore, those crops will not be larger by reason of the Cuban reduction. There is also a reduction in Porto Pico—this year's crop being 551,000 tons against 589,760 tons in 1925. In Hawaii there are 34,814 tons less, while the Philippines production is 156,064 tons short of last year. In line with this policy, United States beet sowings have been reduced, with the result that the crop of 1926 was only 804,439 tons against 974,185 tons in 1925. These figures show that without any concerted action among the farmers, they voluntarily and for their own welfare saw the advantage of changing some of their lands to the cultivation of other products than sugar. Even the European countries have realized the wisdom of reducing their crops. The reduction in Czecho-Slovakia is of special importance on account of being the only country with a large exportable surplus, her sugars coming into competition with Cubas in the United Kingdom and other markets. From the foregoing it will be readily realized that the limitation of the Cuban crop is economically sound.

"During the World War when European beet production was very much reduced and there was a world scarcity of sugar, Cuba was encouraged to increase her production, especially by the United States Government. Every possible assistance, financial and otherwise, was afforded for that purpose. Cuba, with her enormous resources, responded to the world's call for sugar in the most energetic possible way, so much so that production increased from 2,597,732 tons in 1913-14 to 3,446,093 tons in 1917-18. So great was the stimulation during the war that production could not be reduced abruptly, but it kept on increasing until last year it reached 5,125,970 tons. The impetus imparted to the Cuban sugar industry during the war could not be checked speedily enough to conform to the world's sugar requirements.

"When Cuba made the enormous effort of providing the European Allies with sugar, she should have insisted upon those countries entering into an agreement whereby, after the limitation of the war, they would be obligated to continue buying Cuban sugar in preference to sugars from other countries. The Allies should also have agreed to refrain from introducing high tariffs against Cuba after the war or given much preferential consideration to home production and Island possessions. Had Cuba done this, we would not now see England with a high tariff, granting a high preferential to her Colonies, and what is still worse, artificially stimulating the production of beet sugar at home by paying a tremendously high subsidy. On this account, Cuba's market in the United Kingdom has been considerably limited by reason of the imports from Australia, Mauritius, Natal and the British West Indies.

"In order to protect the Cuban sugar industry, there was no alternative left but to curtail production through Governmental control and therefore to adjust production to conform with the requirements of the United States and Europe. It is evident that the Cuban curtailment and consequent higher prices will benefit all other producing countries in the world, but as Cuba receives no preferential treatment except in the United States, where she does not derive the full benefit thereof, she is forced to control production."

Crop Prospects Elsewhere.

The European beet crop, according to Licht's third estimate, will cover 2,182,000 hectares, as compared with 2,134,334 hectares last year. Sweden has reduced her area from 30,000 to 5000 hectares following on a refusal of her Government to give the industry financial assistance; Czecho-Slovakia, France, and Denmark show slight decreases, Germany and Poland some increase, while Russia foreshadows an increase of 30,000 hectares, which is the main reason for the European total being higher this year than last.

Hawaii's crop just completing is expected to produce 645,000 long tons as compared with 692,804 tons last year; Java's coming crop (1926-27) is expected to be 10 to 15 per cent., i.e., more than a quarter of a million tons less. WILLETT & GRAY now give their estimated increase in the world's production of sugar as 691,575 long tons over the crop of 1924-25, which was 23,649,967 tons; this is a big drop in the annual increase, which in 1923-24 was nearly two million tons over 1922-23, and in 1924-25 three and a half millions more than in 1923-24.

Mechanical Cultivation in Canefields a Desideratum.

In an article appearing in the *Louisiana Planter* a short while ago, from the pens of H. MCLAREN, Jr., and H. N. VAN DIJK, the proposition is put forward that owing to the increased demand for sugar that is developing in the world generally, consumption may eventually once more overtake supply, especially having regard to the fact that in so many of the principal producing regions difficulties arising from shortage of labour, or at any rate of cheap labour, will militate against any marked expansion of the world's total acreage under sugar. The solution of the problem would appear to be the introduction of more modern labour-saving methods. In the factories so much has already been done that little marked improvement is to be expected; but in the fields there is still considerable scope for more modern systems of cultivation. In Cuba, for instance, mechanical cultivating machinery, proper drainage and irrigation, the use of fertilizers, and the planting of only suitable varieties of cane would make a considerable difference in the productiveness of the cane lands, especially those bearing evidence of considerable exhaustion. The writers of the above article go on to claim a great saving in the costs of production by laying out estates in such a way as to allow for a high degree of mechanical cultivation and with the minimum use of manual labour.[1] And a beginning is said to have been made in Java to modernize many of the existing estates so as to enable mechanical ploughing to prepare the fields within a much shorter time than manual labour can accomplish; the effect of this is to enable a much larger acreage of land to be planted at the right moment, from which results a more perfect yield of cane than is obtained from late planted fields.

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[1] Mr. H. MCLAREN, Jr., is a member of the firm of J. & H. McLaren, of Leeds.

Production Costs in Leading Countries.

The most interesting feature of the above-mentioned article is, however, undoubtedly the set of figures collated from various sources showing the cost of production in five leading cane and beet sugar countries, viz., Cuba, Java, Germany, Czecho-Slovakia, and Holland. These are as follows:—

	Cost of Production of 1000 kg. of Cane or Beet delivered at the Mill				Cost of Manufacturing 1000 kg. of Raw Sugar.				Total Cost of of 1000 kg. Raw Sugar.		
	£	s.	d.		£	s.	d.		£	s.	d.
Cuba	7	9	2	..	4	0	10	..	11	10	0
Java..	5	2	6	..	4	10	2	..	9	16	8
Germany	8	15	0	..	5	5	0	..	14	0	0
Czecho-Slovakia	7	15	8	..	3	14	4	..	11	10	0
Holland	9	15	2	..	3	14	10	..	13	10	0

The Cuban price is that of the most conveniently situated factories—less favourably situated ones go up as high as £12 13s. 4d. The Java figure is an average one. The beet figures are based on a content of 18 per cent. In Germany the cost of manufacture has increased by 202 per cent. since 1914, and the cost of beet by 40 per cent. The figures show generally that the costs of manufacture are approximately the same in all modern factories[1]; the main differences lie in the costs of production in the fields, and these suggest that the cane producers have more in hand should costs of production rise further with them, while by the greater adoption where possible of mechanical cultivation and a reduction in wage costs, further economies are achievable.

British Beet Production.

There has been much less publicity in this country the last two months over the expansion of the beet sugar industry, and the press generally has been much quieter on the subject. It is, however, the time of the year when the season's sowings are fixed irrevocably, and new factory schemes cannot aim at an earlier campaign than the one beginning at the end of 1927. Most of the projected factories for the coming campaign are under way, though the upheaval of the general strike and the creeping paralysis of the prolonged coal stoppage are bound to have an effect on the completion of work, that cannot be gauged for the time being. A few of the projects that have previously been reported have latterly been abandoned, in the main because there was not sufficient acreage of beet guaranteed. Thus, we understand that the Barlow scheme of the United Sugar Co. is not being proceeded with, the Bardney factory has been abandoned for the time being, both the Greenock and the Wissington ventures have encountered financial difficulties that will handicap them for operating this year; then the Selby project has to all appearance been dropped. The principal new factories now being built are at Cupar (Fife), Felstead (Essex), Poppleton (Yorks.), and Peterborough. The Yeovil project is held up till a much larger acreage of beets can be obtained.

Toxic gases have been tried in Louisiana for the extermination of the borer in cane; but, though most of the insects were killed, the method is less favoured on account of cost and convenience than the hot-water treatment.

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[1] What differences there are may be partly due to the "all-in" cost figures not being identical in each case. For instance, the Java figure may include carriage expenses not given by the others.

Fifty Years Ago.

From the "Sugar Cane," June, 1876.

In this number of our predecessor, there was a long description of the process invented by W. EATHORNE GILL for clarifying cane juice, from which description the following extract is made:—"Although I scum, subside, and filter the cold cane juice no less than five times in the tank, and it flows out as fast as it enters, there still remains in the juice an impurity so fine, as not to be detected by the unassisted eye. Fortunately this impurity expands by heat to upwards of 30 times its original bulk, to float as scum on the surface of the juice in the pan. It were well to be attentive to this, by gradually raising the temperature until a scum rises to be immediately removed, getting off all the scum, if possible, by stages of temperature, before the juice boils. . . . . . It will be seen at once, that the old plan of "cracking" the scum is an error to be avoided. When the sugar-boiler finds his cane-juice perfectly clarified, which is indicated by no more scum rising to the surface, he may then proceed to add lime cautiously, but not before. I prefer to do this by means of a sieve, or other similar contrivance. I throw the lime therein, and wash it out by a jerking motion, when it is partially immersed in the syrup on the "copper wall," throwing away whatever remains in the sieve. To determine the proper quantity . . . . . I use litmus paper . . . . . I prefer a pale rose-colour. This nice adjustment, on which so much depends, will be amply repaid by a superior sugar product, in quantity as in quality . . . . which involves the necessity for lime at the proper time—of course not the extravagant quantity of lime that is too frequently employed, as if with a determination to produce molasses at the expense of sugar. As the duration of fermentation becomes an important element to govern the amount of lime, it follows that, the shorter that duration, the less lime may be required to correct acidity. We can now see at a glance the desirableness of getting the juice into the tank from the mill, with the utmost promptitude. When in the tank, the cane-juice submits to the action of galvanism, self-generated, so to speak, which galvanism coagulates the albumen, albuminoids, etc., to float there as scum, promptly depriving these chief agents of fermentation of the power to ferment and produce acidity. I think it was Professor BRANDE who found galvanism capable of coagulating albumen in saliva, when chemicals failed him. He was thus able to precipitate and weigh all the albumen contained therein, although it formed but the seven thousandth part of the saliva. Professor HOFFMANN confirmed the accuracy of this delicate test, and the recent analysis by gentlemen skilled in the higher branches of chemistry, by different methods, confirmed BRANDE's results. FARADAY's discoveries in galvanism enable me most inexpensively and efficiently to carry them out in practice, with suitable modifications, and thus utilize them, against which there is no law. So, then this self-engendered galvanism (aided by the flowing juice) coagulates the liquid impurities contained in the cold cane juice, causing them to became inert, and float as scum in the tank; and filtration and subsidence there allows the juice—now clarified to escape as freely as it enters the tank, without handling, or change of locality, until discharged into the usual pans, to result in the crystallization of all the sugar in superior quality."

Experiments with Sugar Canes on the Estates of the Ste. Madeleine Sugar Co., Ltd., Trinidad.

Reports have been issued of the experiments conducted on behalf of the Ste. Madeleine Company by Mr. G. A. JONES, the agronomist in charge of field experiments, in order to ascertain which varieties of sugar cane are most suitable for cultivation on the estates of the Company, some twelve in number, the problem being to find canes of high ratooning power capable of giving good returns on soils of diverse character, which in many instances are difficult to till and are of low, or only moderate, fertility. Experiments are also undertaken to ascertain the most appropriate manurial treatment under these conditions.

Five main types of soil are recognized: the black soils which are fertile and in good condition, though they are heavy and require careful tilling and draining; the canes growing on these soils are seldom attacked by froghoppers. The brown soils are of less fertility, being heavier in texture; varieties of canes other than Uba seldom give satisfactory returns on these soils. The red soils consist of a well defined series of heavy soils deficient in lime and difficult to work; of the canes hitherto grown only Uba gives satisfactory ratoons on them and the canes grown on these soils are very subject to the attacks of froghoppers. The older alluvial soils are heavy and deficient in lime, not easily worked and as a rule only growing ratoons indifferently; Uba alone gives satisfactory returns beyond first ratoons, but that cane will ratoon satisfactorily for several seasons. The newer alluvial soils are now only being brought under cultivation; they are fertile soils which produce good crops of canes other than Uba and the canes grown on them are seldom attacked by froghoppers.

The experiments with varieties fall into several categories. The first series was started in 1921 on the older alluvial soil at Harmony Hall, the plant canes being reaped in 1923 and the ratoon in 1924 and 1925. The land in this and the following series received 20 tons of pen manure before the canes were planted and the experiments were laid out in duplicate on plots of one tenth of an acre. The following returns were obtained from the three crops.

Name of cane.	Tons of cane per acre.				Sucrose per cent. of cane.	Average tons Sucrose in cane per annum.
	Plants	1st. Rat.	2nd. Rat.	Average		
D. 625	24.9	33.7	20.8	26.5	13.66	3.62
B. 156	21.7	26.1	21.0	22.9	15.57	3.56
B. 347	21.0	26.5	21.3	22.9	14.33	3.28
B.H. 10 (12)	13.3	24.9	18.1	18.8	17.09	3.21
AR/N. 55	14.9	22.3	17.3	18.2	15.44	2.81
Ba 6032	17.5	25.2	15.3	19.3	13.94	2.69
White Tanna	13.3	22.6	15.5	17.1	12.78	2.18

It is to be noted that Uba cane is not included in this series. The best returns are given by D. 625, whose relatively high tonnage compensates for the small sucrose content. B. 156, which comes next in order of yield, is a well known cane which has long been planted in this district with good results. The variety B. 347 was favourably regarded until lately, but it is said to show signs of deterioration. B.H. 10 (12) at the time these experiments were started was a cane comparatively new to this district.

The results of these experiments, while generally interesting, are not conclusive: in the year following their inception further experiments were laid out on a somewhat more extended scale.

EXPERIMENTS OF 1922 TO 1925.

These consist of a series on black soil at Petit Morne, another on the older alluvial soil at Harmony Hall, both in duplicate, and a third on the older alluvial soil at Taruba; in the latter case the plots were not in duplicate. These canes were reaped as plants in 1924 and as first ratoons in 1925.

Black Soil : Petit Morne, per acre.

Plant canes, 1924.				1st. Ratoon canes, 1925.			
Cane.	Tons cane.	Per cent. Sucrose	Tons Sucrose	Cane.	Tons cane.	Per cent. Sucrose	Tons Sucrose
B.H. 10 (12)	45.3	17.07	7.73	Uba	26.8	14.66	3.93
AR/N. 26	44.7	16.09	7.19	B.H. 10 (12)	20.7	17.89	3.70
Ba. 6032	41.8	15.39	6.43	AR/N. 26	18 0	14.31	2.57
Uba	38.7	15.11	5.85	B. 347	17.5	14.41	2 52
B. 347	39.7	14.09	5.60	Ba. 6032	16.4	14.90	2.44
B. 6308	26.9	17.35	4.66	B. 156	14.8	15.39	2.28
B. 156	33.1	13.36	4.48	B. 6032	12.5	15.84	1.98

Old alluvial soil : Harmony Hall.

Plant canes, 1924.				1st. Ratoon canes, 1925.			
Cane	Tons cane.	Per cent. Sucrose	Tons Sucrose	Cane.	Tons cane.	Per cent. Sucrose	Tons Sucrose
B.H. 10 (12)	37.1	17.13	6.36	B.H.10 (12)	31.7	17.89	5.67
Ba. 6032	38.4	15.34	5.88	Uba	36.2	14.66	5.31
B. 6308	36.1	16.02	5.77	B. 6308	30.4	15.84	4.81
Uba	39.9	12.99	5 18	B. 156	29.5	15.39	4.55
AR/N. 26	36.1	14.01	5.06	Ba. 6032	26.2	14.90	3.90
B. 347	37.2	13.10	4.88	B. 347	25.9	14.41	3.73
B. 156	34.1	13.88	4.73	AR/N. 26	23.4	14.31	3.35

Old alluvial soil : Taruba.

Plant canes, 1924.				1st. Ratoon canes, 1925.			
Cane	Tons cane.	Per cent. Sucrose	Tons Sucrose	Cane.	Tons cane.	Per cent. Sucrose	Tons Sucrose
B. H. 10 (12)	32.9	16.60	5.45	Uba	41.8	15.28	6.39
B.156	34.7	15.00	5.21	B. 156	29.5	15.13	4.46
Uba	35.6	13.21	4.70	B.H.10 (12)	21.0	19.06	4.00
AR/N. 26	33.1	13.58	4.50	B. 6308	22.0	15.52	3.41
B. 6308	28.8	15.57	4.49	B. 347	24.6	13.70	3.37
Ba. 6032	30.5	15.12	4.61	Ba. 6032	19.3	15.15	2.92
B. 347	29.2	13.48	3.94	AR/N. 26	19.1	13.84	2.64

While the number of the plots is too small to permit of accurate statistical examination, one or two points may be commented on with reference to this set of experiments. On the black soils the plant canes give larger returns than the 1st ratoons, but on the alluvial soil they tend to approach the plant canes in yield, and it will be noticed that Uba cane shows relatively great ratooning power. It will also be observed how greatly the more suitable canes exceed the less suitable in yield and how considerably the output of an estate may be affected by a judicious selection of the varieties to be planted.

EXPERIMENTS OF 1923 TO 1925.

By 1923 it was recognized that the number of replicates in the previous experiments had been too small to afford satisfactory results and to permit of their statistical examination: in order to bring the work more into line with modern ideas and practice it was decided to conduct the experiments on plots of 1-30th of an acre and to repeat the experiment nine times in each case. Two series of experiments were laid out, one on the black soil at Petit Morne and the other on the older alluvial soil at Harmony Hall. The canes were planted in

September 1923, and reaped in 1925, the land receiving pen manure at the rate of 20 tons per acre. The following tables show the mean results, calculated as yields per acre.

Petit Morne. Black soil. Plant canes reaped 1925.

Cane.	Tons cane.	Probable error of mean per plot.	Probable error of mean per cent.	Prob. error of a single result per cent.	Cane per cent. Sucrose	Tons sucrose.
B.H 10(12)	26.3	±0.6	±2.28	± 6.84	17.45	4.59
Uba	30.9	±0.5	±1.62	± 4.80	13.95	4.31
S.C. 12/4	28.6	±1.7	±5.94	±17.80	14.89	4.26
Ba. 6032	29.9	±2.8	±9.36	±28.10	13.71	4.10
Ba. 11569	26.5	±1.6	±6.04	±18.10	15.23	4.07
B. 156	22.5	±1.4	±6.08	±18.24	14.67	3.30
B. 6308	20.9	±0.6	±2.87	± 8.60	15.51	3.26
B. 4934	20.1	±0.9	±4.47	±13.40	15.00	3.01
B. 1753	15.4	±1.1	±7.14	±21.40	14.44	2.22
B. 3922	13.2	±1.1	±8.33	±25.00	15.20	2.00

Harmony Hall. Old alluvial soil. Plant canes reaped 1925.

Cane.	Tons cane.	Probable error of mean per plot.	Probable error of mean per cent.	Prob. error of a single result per cent.	Per cent. Sucrose	Tons sucrose.
B.H. 10 (12)	33.8	±0.8	±2.36	± 7.1	17.03	5.76
S.C. 12/4	35.0	±0.6	±1.71	± 5.1	16.14	5.65
Ba. 6032	36.0	±1.1	±3.06	± 9.2	14.59	5.37
Ba. 11569	37.9	±1.7	±4.57	±13.7	13.73	5.20
Uba	37.2	±0.9	±2.42	± 7.2	13.29	4.94
B. 156	34.9	±0.65	±1.86	± 5.9	14.15	4.94
B. 347	32.3	±1.2	±3.72	±11.2	14.42	4.66
B. 6308	32.0	±0.6	±1.87	± 5.6	14.54	4.65
B. 3922	27 3	±1.3	±4.76	±14.3	14.88	4.06

In the foregoing tables the results are arranged in the order of the amount of sucrose in the canes : the canes grown on the alluvial soil at Harmony Hall gave better results than those grown on the black soil at Petit Morne ; this is probably due to the better rainfall at the former place. The same six varieties are found in the upper half of each table, leading to the presumption that these six canes are better suited to this region than the others. The highest return is given by B.H. 10 (12) owing to the high sucrose content of this cane, and this is closely followed by S.C. 12/4.

The probable errors of the means of the results have been calculated with reference to the weight of cane, but not in respect to the tonnage of sucrose ; it is hoped that the latter may be recorded in future reports. It is to be observed that the probable error of the mean and of a single result is high in a number of cases, thus indicating how difficult it is to secure a high degree of accuracy in field experiments with varieties of sugar canes and showing that in such experiments nine replicates of each experiment are insufficient to ensure statistically conclusive evidence.

In order to ascertain the nature of the statistical evidence afforded by these experiments, the yields of canes in each of the two sets have been compared with those of the cane B. 156, a cane which for some time was regarded in this district as a standard variety of good average quality. The following table gives the results. In order to be statistically significant the difference in yield should be not less than 2·5 times the error of the difference ; when this is the case the variety in question is certainly definitely better (or worse), than B. 156. Judged in this manner it is seen that in the Petit Morne series S.C. 12/4 and Uba are certainly better as plant canes than B. 156, and that B.H. 10 (12) approximates closely, while there is strong probability in favour of Ba. 6032. On the other hand, B. 1753 and B. 3922 are undoubtedly inferior.

Petite Morne.—Comparison of yields of Canes (tons) with B. 156.

Cane.	Tons cane.	Difference from B. 156, per plot.	Prob. error of difference per plot.	D E_d.	Diff. per cent. on B. 156.
B.H. 10 (12)	26.3	3.8	±1.55	2.45	16.8
Uba	30.9	8.4	±1 52	2.52	37.3
S.C. 12/4	28.6	6.1	±2.22	2.77	27.1
Ba 6032	29.9	7.4	±3.14	2.35	32.9
Ba. 11569	26.5	4.0	±2.15	1 86	17.8
B 156	22.5	—	—	—	—
B. 6308	20.9	—1.6	±1.53	1.04	—7.1
B. 4934	20.1	—2.4	±1.70	1.40	—10.7
B. 1753	15.4	—7.1	±1.61	4.40	—31.5
B. 3922	13 2	—9.3	±1.61	5.70	—41.3
Harmony Hall.					
B.H. 10 (12)	33.8	—1.1	±1.02	1.08	—3.1
S.C 12/4	35.0	0.1	±0.88	0.01	0.3
Ba. 6032	36.0	1.1	±1 27	0.80	3.2
Ba. 11569	37.9	3.0	±1.82	1.60	8.6
Uba	37.2	2.3	±1.11	2.07	6.6
B 156	34.9	—	—	—	—
B 347	32.3	—2.6	±1.36	1.91	—7.5
B. 6308	32 0	—2.9	±0.88	3.30	—8.3
B. 3922	27.3	—7.6	+1.45	5.20	—21.7

The Harmony Hall series yield less definite information, except that it is clear in this case that the canes B. 6308 and B. 3922 are inferior to B. 156 under the conditions of the experiment.

The results recorded in this series deal only with plant canes; the continuation of the work will give information concerning the ratoons; this will be of interest and importance, seeing that the view is prevalent in this district that the success of the sugar industry is dependent on good ratooning.

The Uba cane is finding favour for cultivation on the poorer soils of this district, for it is hoped that while giving remunerative returns it may make it possible to handle poor and difficult soils and bring them into such condition that better varieties may be grown on them. For these reasons it will be well to note carefully the behaviour of the better types of canes so as to permit of the selection of the most suitable with some degree of assurance as the condition of the soil is improved: in this way the use of Uba cane may prove to be only a stepping stone to better conditions.

It may be interesting to note that, while on these estates in Trinidad it is sought to stabilize conditions and to secure increased returns by ratooning, in Barbados this result has been achieved in many cases by entirely eliminating ratooning and growing plant canes only. Probably this difference in tactics may be explained by such circumstances as the greater difficulty of tilling the soil in Trinidad, the greater difficulty of controlling weeds and the relative scarcity of labour, the cost of growing plant canes in Trinidad being comparatively so much greater that reliance is placed on ratoons; at the same time, in Trinidad, ratoons frequently give heavier returns than plant canes, which is not usual in Barbados. Each Colony is probably right in its selection of the manner in which its problems in this connexion are to be met.

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Experiments with Sugar Canes in Trinidad.

MANURIAL EXPERIMENTS.

In addition to experiments to ascertain the most suitable varieties of cane for cultivation, several series of manurial experiments were also undertaken.

The first series was carried out on alluvial soil at Harmony Hall using plant canes of two varieties, Ba. 6032 and Uba. The object of this series was to ascertain the effect of pen manure and of various combinations of potash, phosphate and nitrogen, the latter as sulphate of ammonia, when applied in addition to 20 tons of pen manure per acre. There were ten replicates of each experiment in the Ba. 6032 series and nine in that of the Uba.

Only in the Uba group was there a series of trial plots receiving no manure. When these and the plots receiving pen manure are compared it is found that the application of 20 tons of pen manure increases the yield by 7·8 tons of canes, an increase of 23·7 per cent. and, as this increase is more than nine times the error of the difference, it is statistically highly significant, amounting to practical certainty. The extent to which this is remunerative will depend on the value of the canes and on the extent to which the manure tends to increase the yield of the ratoons: experience has shown that the residual effect of pen manure is considerable. As regards the plant canes an increase of 7·8 tons of cane may be taken as worth from £5 17s. 0d. with (Uba) canes at 15s. 0d. a ton to £7 16s. 0d. at 20s. 0d. a ton, so that there would be little or no gain on the plant canes, for the pen manure may be valued at 8s. 0d. or 10s. 0d. a ton or over. It is not safe, however, to deal summarily with this result, for it is more than probable that the residual effect of the pen manure on the ratoons will be considerable and that in the long run there will be some gain. The result of reaping the ratoon canes is, therefore, awaited with interest.

The report refers to the application of an additional 20 tons of pen manure, 40 tons in all, resulting in a gain of 2·8 tons of cane per acre, an increase which would not be profitable: it is concluded, therefore, that applications of about 20 tons of pen manure per acre are sufficient: a conclusion of some practical importance.

The application of 60 lbs. of nitrogen as sulphate of ammonia resulted in small increases of yield only, about 2½ tons of cane per acre, and it appeared to effect little difference whether this application was divided into two doses or applied as one, or whether it was combined with phosphate and potash. Increasing the amount of nitrogen to 80 lb. did not increase the yields.

Utilizing the results obtained in the series of experiments receiving 20 tons of pen manure, the yield of all the 36 plots of Uba cane receiving 60 lb. nitrogen as sulphate of ammonia is compared with those receiving none, also 36 in number; the former gave an average return of 42·4 tons of cane per acre, the latter 40·0 tons, a difference of 2·4 tons. As the error of the mean in each case is ±0·1, the increase is entirely significant, and it may be taken that when an application of 60 lb. of nitrogen is given to land receiving 20 tons of pen manure per acre an increased yield of 2½ tons of cane may be expected. It is pointed out that as it would cost about £2 10s. to produce this additional quantity and that, as at the present low price of sugar the additional yield would be worth less than £2, a loss would result.

A similar conclusion is arrived at by comparing 30 plots of Ba. 6032 cane receiving pen manure and 60 lb. of nitrogen as sulphate of ammonia with 40 plots receiving pen manure only; the former yielded 45·2 tons of canes per acre against 42·3 from the latter; a gain of 2·9 tons. This, while statistically significant, is not remunerative.

The general conclusion is reached that when 20 tons of pen manure are given to plant canes no remunerative gain follows from the application of nitrogen or of mixed fertilizers containing potash phosphate and nitrogen, so far as the soils of the estates in question are concerned. This is in accord with the conclusions reached in the Leeward Islands many years ago.

Experiments are reported showing the results obtained from the application to 1st ratoons of nitrogen either given in one dose or divided into three. The differences observed were small and not statistically significant, and the view is expressed that there is no advantage to be gained by making frequent small applications of this fertilizer as compared with one application. It is to be noted however, that these 1st ratoon plots receiving nitrogen gave on an average 2·5 tons more cane than those receiving none, a difference which is significant, but not remunerative.

A series of experiments with 7th ratoon Uba canes is recorded in which 10 plots receiving no manure are compared with 19 plots receiving 60 lb. per acre of nitrogen as sulphate of ammonia. The unmanured plots gave at the rate of 17·6 tons of canes per acre; those receiving nitrogen gave 22·7, a gain of 5·1 tons, or 29 per cent.; this difference is significant and would be remunerative.

Many other experiments in manuring ratoon canes were made but the results were inconclusive, owing in many cases to the invasion of froghoppers.

In view of the importance attaching to ratoon canes, the results of the experiments which should become available in 1926 are awaited with some degree of interest.

It is interesting to note that manurial experiments with sugar cane, where only one variety of cane is under observation in each series, appear to admit of greater accuracy than is obtainable in the case of experiments with varieties, where one variety is contrasted with another; for in the manurial series the probable error of a single result ranges from 2·2 to 7·0 per cent., as was observed in the experiments conducted with plant canes at Harmony Hall; whereas in the varietal tests the probable errors of a single result range from 5 to 28 per cent., so that while nine replicates may be enough for accuracy in manurial experiments, more are required in variety trials.

A direct shipment of sugar from the West Indies to Wallaceburg Refinery, Ontario, is reported, and is believed to be the first instance of a fixture for sugar of a vessel direct to a Great Lakes port from the West Indies. Previously, sugar was trans-shipped by rail, or carried in smaller vessels through the canal to the Lakes.

The coming installation of the Petree process in Central Machete in Porto Rico is announced. This is the second factory and the third unit put in operation by the CENTRAL AGUIRRE SUGAR Co. In 1924 this company installed two complete units in its largest factory, i.e., Central Aguirre, where they are now about to finish the third season. The fact that this company is the largest and most successful sugar producer in P.R. lends particular significance to this order. The development of this process is being followed with considerable interest in all cane sugar countries.

Java's average yield of sugar for 1925 crops in long tons per acre (as *hoofdsuiker* No. 16,) was 5·13, compared with 4·0 for 1924. Sut Ni Quar[1] reports that in comparative field tests the two new varieties, Nos. 287 and 2883, proved superior to the previously best known ones, such as EK 28, DI 52 and No. 247. These two numbers, both developed from a single seedling in 1921, are believed to be capable of greatly increasing yields if generally adopted. Profits (or losses) being made in the field, and many companies in in Java having operated last year on a very narrow margin, great hope is entertained for these new canes in the future.

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[1] *Facts about Sugar*, 1926, 21, No. 4, 80, 82.

Decolorizing Carbons; Their Suitability for Sugar Refining.

Reply by the Suchar Process Corporation.

Following the publication of the investigations conducted by Messrs. A. A. Blowski and J. H. Bon,[1] of the California and Hawaiian Sugar Refining Corporation, of Crockett, Cal., U.S.A., Mr. Leonard Wickenden, Vice-President of the Suchar Process Corporation, has issued a reply,[2] the substance of which is here given.

REMOVAL OF NON-SUGARS.

One of the chief criticisms of vegetable carbons, repeatedly either made or implied, is that they do not adsorb non-sugars. For instance, the authors state: "The resulting liquors, even if sufficiently decolorized, would not be of high enough purity."

This can only be interpreted to mean that they do not consider the removal of colour to be indicative of removal of impurities. All their experiments show that activated carbons remove from 40 to 99 per cent. of the colour present in sugar solutions of various kinds. It is impossible to believe that the authors assume that this "colour" is imponderable. They could very easily have convinced themselves that it has weight, simply by weighing the washed carbon after use, when they would have found an increase of from 25 to 50 per cent. Since the removal of colour is certainly not due to removal of sugars, to what else can it be ascribed than to the removal of non-sugars?

AFFINATION SYRUP TREATMENT.

It seems to us, however, that almost the whole of section IV of the article[3] is based on a false premise. The refiner can either run the syrup over partially exhausted char, and then boil to sugar, or he can boil direct without previous filtration. The authors assume, however, that the former procedure is universally adopted in bonechar refineries, while the latter (known as the "crystallization method") is peculiar to vegetable carbon operation. This is far from being the case. The prefiltration of the affinations over bonechar is looked upon with disfavour by many bonechar refineries; and, on the other hand, there is nothing to render the filtration of affinations with vegetable carbons impossible, either from the technical or the economic standpoint. Mr. Geoffrey Fairrie[4] writes:—

"In some refineries the surplus affination syrup is heated and diluted and then passed through cloth filters. . . . . after which it goes through animal charcoal filters. . . . . The gummy impurities cause trouble at the cloth filters . . . . . the resultant crystals are rarely hard enough to rank as a first grade sugar. . . . . For these reasons, *the crystallization method is the more generally used.*"

On the other hand, the chief advantage of the char treatment of affinations lies, as the authors state, in the removal of some non-sugars, but whether this advantage outweighs the disadvantages is at least open to question, and according to Mr. Fairrie, who, we believe, is considered both in this country and in Europe as something of an authority, the majority consider that the crystallization method is more economical. Should, however, a refiner prefer to use the filtration method with vegetable carbons, there is nothing to prevent his doing so.

The authors do not show in detail the calculation by which they reach the conclusion that the crystallization method involves an increase of 140 per cent. of the burden on the remelt pans. In view of the fact that the crystallization method does not require the dilution of the affinations, with their subsequent concentration, and considering that in the vegetable carbon process there is no sweet-water to evaporate, we feel that a more detailed demonstration is needed before the point can be considered fully proved.

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[1] *I.S.J.*, 1926, 203-208 and 255-260.
[2] *Facts about Sugar*, 1926, 230-231.
[3] *I.S.J.*, 1926, 255-260.
[4] Geoffrey Fairrie, "Sugar," p. 66.

The real facts are that the liquors produced from the ordinary refinery melt by our activated carbon are of such high purity and degree of decolorization that they can be boiled to five strikes of standard refined sugar before being sent to the remelt pans. We believe it will be admitted that no more can be said for the average bonechar liquor. Because of this fact, and because of the lower inversion losses due to the shorter time in process, and the elimination of loss involved in washing bonechar, the recovery of sucrose in the "Suchar" process is slightly higher than in the bonechar process. These facts are readily available, and we can at any time refer the authors to authorities of unquestioned standing and ability, who will confirm our statement. Mr. C. C. KRUMBHAAR,[1] associate manager of the estate of H. C. MINOR, wrote : "The melt, mixed with 1 per cent. carbon on solids, using "Suchar" . . . . was kept hot while being pumped through filters. . . . The liquor is boiled to white sugar. . . . With "Suchar" we were enabled on account of the almost perfectly decolorized liquors and high purities to boil many times for granulated sugars."

FILTRATION OF MELT LIQUORS.

The authors also assume that the melt liquors are subjected to a triple filtration with activated carbons. They state : "This laboratory test approximates the three-stage decolorization process to which the melt liquor would be subjected in actual operation. . . . . The writers have never been able to produce anything approaching a refinery granulated liquor with less than a three-stage process."

This is indeed surprising. With our own carbon, a three-stage filtration has never been used, and as far as we are aware, the same holds true of all other carbons. A two-stage filtration is common, but if a three-stage filtration has ever been used, the conditions must have been most unusual, and under no possible interpretation of the facts could such a procedure be considered standard practice. Further, it is difficult to reconcile the authors' second statement, quoted above, with the results which they report in their paper. They state that a 98·2 per cent. decolorization gives a "satisfactory" granulated liquor, and we believe that any one familiar with sugar-house practice will agree that such a liquor would be *very* satisfactory. Yet we find that with a *single* filtration they succeeded in removing over 99 per.cent. of the colour from a washed sugar liquor. Still more striking results are shown, as using only 4 per cent. carbon the authors succeeded in removing 99 per cent. of the total colour, in spite of the fact that the purity of the washed sugar was only 98·8, instead of over 99, which they state to be the purity commonly used in bonechar refineries. Finally, using apparently a melt of the same sugar, but using now bonechar in place of the decolorizing carbons, they succeeded in removing only 96·5 per cent. of the colour, even with 100 per cent. of the bonechar. In view of these experimental results, the statement quoted above requires further explanation before it can be understood.

In a report made by one of the leading sugar chemists in this country, connected for many years with one of the large bonechar refineries in the East, the following sentence occurs :

"The prefiltration with once-used "Suchar" reduced this (the colour) to about 2·5, and the second filtration with freshly revivified "Suchar" reduced it further to about 1·2, giving a liquor of a better colour than is frequently the case with *first* liquor from boneblack. The liquor was always very brilliant, after even the first filtration, and proved quite satisfactory for boiling to granulated sugar." This was operating on Cuban raws.

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[1] *La. Planter.* 1924, 58.

Three weeks later the same investigator wrote: "The colour of the liquor and its purity compared favourably with that obtained in boneblack refineries and gave no trouble in working. Five strikes of granulated sugar were boiled from these liquors and this is better than is often done in boneblack refineries."

USE OF FILTER AIDS.

Further, the authors state: "The carbon process . . . . has not been so much concerned with high quality" and: "It would probably develop that in order to insure absolute clarity a final filtration of decolorized liquors with a standard filter-aid would be necessary."

No filter-aid of any kind is used either before or after the carbon treatment. We suggest purchasing on the market a sample of any standard granulated sugar made by any refiner using the bonechar process, and comparing it as regards colour, appearance and purity with the Suchar sugar. Suchar sugar has been on the market since the fall of 1923, competing successfully with sugars made by the bonechar process.

REVIVIFICATION OF CARBON.

There is an unsupported statement to the effect that "carbon used on unfiltered liquors suffers a gradual reduction in filtration efficiency." That certainly is not true of all carbons. At the time the authors presented their paper, many hundreds of cycles of "Suchar" revivification had been carried through successfully, and we could have referred them to those who, we are sure, would gladly have testified that the filtration properties of revivified "Suchar" are fully equal to those of virgin "Suchar".

The Swedish Government recently decided to refuse to grant a subsidy to the sugar beet industry in that country, and a discontinuance of sugar production is expected as a consequence, with its corollary of increased importations. Agriculture in southern Sweden will undergo some re-organization, with changes to other crops.

At a meeting of the creditors of the ORCHARD SUGAR CO., LTD., of Greenock, held on May 19th, it was decided to adopt a scheme of reorganization submitted by a committee, according to which all creditors over £10 should accept debentures of the proposed issue in satisfaction of their debt to the extent of half, agreeing to a moratorium to extend until funds are available from the next season's operations for the settlement of the remainder of the debt.

Prof. Dr. FRANZ VON SOXHLET, whose name is so well known to sugar chemists, died recently at the age of 78 years. Among the processes with which his name is identified are: modifications of Fehling's and of Sachsse's solutions; determination of reducing sugars and of lactose; estimation of two sugars in admixture. And among the apparatus invented by him are a drying oven, an auto-clave, an extractor, and a filter-tube. Latterly he was Emeritus Professor of Agricultural Chemistry at Münich, while formerly he held the post of Director of the Central Agricultural Experiment Station.

The death at 76 is announced in Boston of an old reader of ours in the person of Mr. EDWIN F. ATKINS, for many decades a prominent member of the sugar trade. Born in 1850, he became a partner in E. ATKINS & Co. in 1874, and since 1888 when his father retired from the firm he had been head of the business till his own retirement in April last. His firm was interested in sugar factories in Cuba, starting with Central Solodad, and at one time owned and worked a refinery in Boston, which subsequently was taken over by the American Sugar Refining Company. Mr. ATKINS was considered one of the leading experts on sugar in the United States, and his death will leave a gap.

The Transmission of Streak Disease of Maize by the Leafhopper Balclutha Mbila Naude.[1]

In previous papers, summarized by the writer,[2] STOREY had obtained evidence that the transmission of streak disease in the maize could be effected by *Balclutha mbila*, a small Jassid insect, but failed to transfer it as between sugar cane and maize either way. A certain amount of success was however obtained in experiments between diseased and healthy sugar canes, so that he was able to conclude that "under suitable conditions it is possible for the insect to transmit streak in sugar cane, but these conditions are obscure at present." The present paper covers much of the same ground, but is of a somewhat different and more scientific character, and is confined to a discussion of the experiments with maize. It is obvious that this study is a preliminary to that of the transmission in the sugar cane, and thus must be regarded as a distinct step in the direction of clearing up the many difficulties met with in the latter crop.

The paper commences with the following useful summary of diseases of the mosaic type : "Within recent years there has been recognized a group of plant diseases which, although transferable experimentally, have failed in microscopic or cultural study to give evidence of a recognizable parasite. In the denomination of this unknown pathogenic agent the term *virus* has acquired a special significance. The virus of certain of these diseases has been shown to pass a filter capable of holding back the smallest visible bacteria ; the majority of workers now regard the virus as an organism which exists, at least during part of its life-cycle, as particles of an ultra-microscopic size.

"Although known only by their effects, the plant virus diseases form a well-marked group, with many characters common to all. In general, infection of a plant results in a derangement of its normal growth processes, without causing the death of any part. The most frequent visible effect is upon the chlorophyll-forming mechanism, producing partial chlorosis, noticeable as a mottled or mosaic pattern upon the leaves. In many cases reduction of power of growth may be extreme, so that stunted and malformed leaves develop, frequently massed to give a rosette form." As to inoculation, a few of these diseases have been mechanically transferred from diseased to healthy plants but, in nature, their spread appears to be through the aid of sucking insects, in most cases aphides, but also in a small number by jassids. In certain diseases, moreover, infection is limited to vectors of one species only (as in many animal diseases); and this the author regards as of special interest, as suggesting the necessity for the development of the virus within the insect—opening up a wide field of study both of the plant and the carrier of the disease.

The markings produced by streak upon the maize leaves are very clear and striking. They are described as broken stripes along the veins, frequently fusing laterally to form composite stripes. These characters are well illustrated by the photographs on the Plate which is here reproduced. The markings differ, however, from those on the sugar cane, in that they are not usually clear and transparent, but have a more or less opaque yellow tinge when viewed by transmitted light : they are nearly evenly distributed over every leaf after infection has taken place. Sufficient evidence is adduced to show that, upon infection, the virus passes down the leaf attacked to the main stem, and thence upwards to the growing point. Once arrived there, the markings are seen on any new leaves being formed, often only on the base at first, as this part is still undeveloped while the upper part of the leaf has ceased growing. Soon however, the markings extend over the whole

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[1] H. H. STOREY. *Annals of Applied Biology*, Vol. XII, No. 4, November, 1925.

[2] *I.S.J.*, 1925, pp. 472-479.

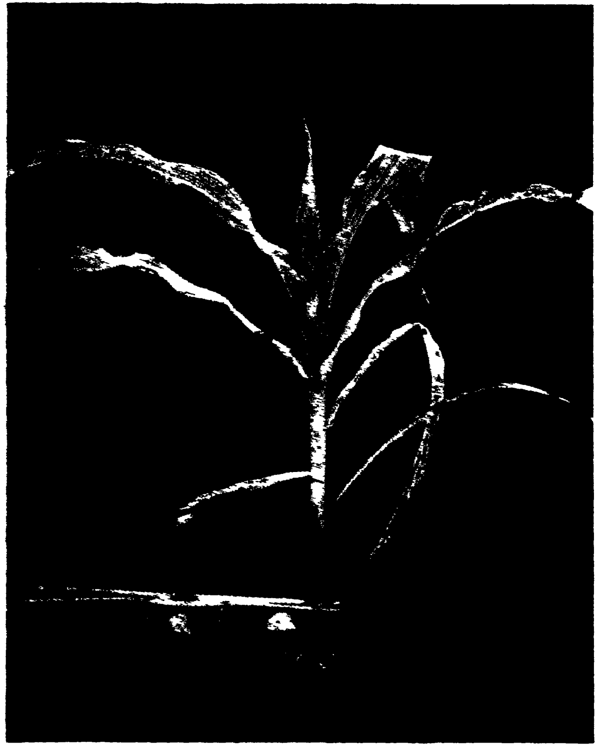

FIG 1

Streak disease fully developed. A maize plant naturally infected in the open at an early stage of growth, showing the typical disease pattern

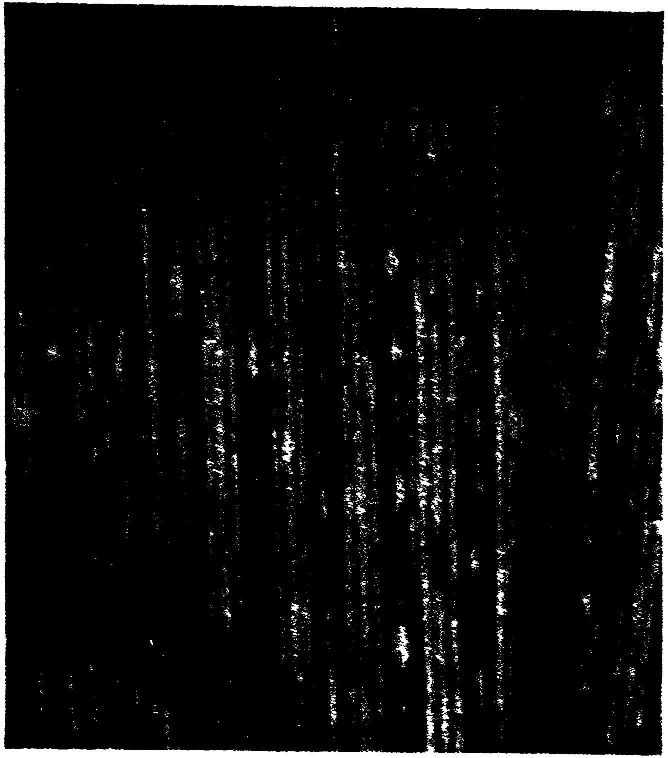

FIG. 2

The streak disease pattern. Portion of a streaked maize leaf, photographed by transmitted light showing chlorotic stripes, following the leaf veins and frequently fusing laterally of the succeeding leaves, to the end of the plant's growth. "In conformity with this course of development, every diseased plant may be expected to bear some fully green leaves at its base. But the number of such fully green leaves varies greatly in different cases, and plants may be seen in the field in all stages, from that in which only the two lowermost leaves are entirely unaffected with streak markings, to that in which the only signs of the disease are a few insignificant colourless spots, towards the base of the last leaf formed before the tassel appeared." These observations agree with the findings of the author that streak cannot be reproduced by seed and, therefore, that only secondary infection occurs in the maize plant.

It will not be necessary to go into much detail as to the various observations and experiments carried out by the author. The method of determining the size of the supposed insect vector, by protecting the plants, from germination throughout their life, by gauze with different sized meshes, has been described in our former summary: while no insects were found inside the cages with meshes of 30 to the inch and over, these were quickly met with where there were 6 to the inch, and rather later with 16. The insect found was Balclutha, and a trial showed that it could be pushed through the 16 mesh gauze. An additional safeguard, against infection taking place through leaves which had grown or been pushed against the gauze, was supplied by a complete inner casing of wire netting of half-inch mesh, fixed half an inch inside the gauze. The results obtained with the cage method conclusively pointed to Balclutha as the vector in streak disease of the maize, and this opened the way to strictly experimental work in transmitting the disease.

The greenhouse experiments were conducted with a series of maize plants raised from seed under quarantine conditions. In these experiments, by a simple and ingenious method, single leafhoppers were allowed to feed for about a week upon portions of leaves inside 8 in. × 1 in. glass tubes. After this period of feeding, the portion of leaf treated was either removed with the tube or dipped into disinfectant, to prevent the possibility of eggs having been laid, and thus introducing insects into the greenhouse which had been feeding on infected material. The insects were taken from fully diseased maize plots; and the twelve adults dealt with reproduced the disease on the young unfolded leaves of 46 healthy plants, within a period of 7 to 26 days from feeding. Of the remaining plants in the greenhouse, 58 of the 59 remained perfectly healthy, the solitary exception being a plant upon which an escaped jassid had been re-captured. Meanwhile a very full history was recorded of the various transfers of the insects in the tubes from plant to plant, day by day, and the dates on which the disease appeared: four cases are given in detail in the paper, fully demonstrating, among other things, the extraordinary hardiness of these insects as compared with the aphides, and the dexterity with which the experiments were conducted. No insect escaped during manipulation, the danger being rather in the weakening of the elastic bands with which the gauze was kept in position at one end of the tube: the other end was simply plugged with cotton wool, and there was also the possibility of this slipping out.

The next point to determine was that the Balclutha acted simply as a vector, and was unable to produce the infective material itself. For this purpose, it was necessary to breed the insects and thus get hold of their complete life history, allowing them to feed or not for limited periods on diseased plants. Among the 19 insects allowed to feed only on 28 healthy plants (from 2 to 40 days), none caused the appearance of streak during 6 to 8 weeks. About 6C insects were allowed to feed for a week on diseased leaves, and were then transferred to healthy plants. These plants were tested after one month, and over half of them showed the disease within that time. It is interesting to note that, of the males used in the experiments, only 26 per cent. proved to be infective, while the figure was 86 per cent. for the females.

A large number of experiments were tried with *Aphis maidis* and *Peregrinus maidis*, both of which had been regarded with suspicion, and also with quite a series of other insects (including other jassids) found on diseased maize. In no case was the disease observed to be transferred. Field observations showed that, where a thorough search was made in fields of diseased maize in a young stage and under favourable weather conditions, specimens of Balclutha were always collected. These were usually met with resting upon the upper surface of the young leaves forming the terminal cone of the plant. But the numbers were never great; and the author concludes that the apparent frequency in the field rarely exceeds one hopper for 20 plants! Such comparative scarcity is not unknown in other proved cases of the transfer of diseases of the mosaic type by insects; and it must be remembered that jassids are particularly agile in their movements, besides being hardy and long-lived. In one of the four cases mentioned above, where particulars of transfers are given in detail by the author, we see that a single Balclutha was artificially transferred to ten different plants, in all of which it produced the disease, before it died after five months of experiment.[1]

C. A. B.

The Chemistry of Refining by "Norit."

By Dr. P. HONIG.

Chemist, Research Laboratory, General Norit Co., Ltd., Amsterdam

Several large sugar factories in Holland during the last few years have taken up the refining of cane sugar, practising this in the interval between the beet campaigns. These factories are equipped with the "Norit" process, which, during the beet sugar campaign is used for the direct production of white granulated sugar from thick-juice, while after the campaign the "Norit" plant without any change is applied to the refining of raw cane sugar, mostly Cuban, although sugars from Peru, Java and other countries are also worked up.

The technical application of "Norit" has already been described in various previous articles. This communication discusses only the chemical side of the "Norit" process, and emphasizes certain points which are essentially germane to the purification of sugar solutions by decolorizing carbons.

In the following table average analyses of sugar melts from washed Cuban sugar are given, these having been made before and after the application of about 1¼ per cent. of "Norit," calculated on the weight of sugar present in the melt.

As appears from the given figures, the treatment specially affects the surface tension and the colour, the quotient of purity remaining substantially unaltered after the Norit treatment. The ash removal amounts to about 20-25 per cent. of that originally present.

This may give rise to the assumption that "Norit," besides decolorizing the liquor, only acts as a mechanical filtering agent, this action for instance being comparable to that of kieselguhr or infusorial earth. This assumption has been proved to be entirely wrong. If the same washed Cuban sugar melt is treated with 2 per cent. of "Filtercel," in the first place, the liquor is only filtered and not decolorized at all. Further its surface tension is practically unaffected. It appears, therefore, that the substances depressing the surface tension have not been removed by the "Filtercel" to any appreciable extent. This phenomenon of an increase of the surface tension is of preponderating importance for the subsequent refinery operations. It would seem that the rate of adsorption of colloid substances depressing the surface tension is of the same importance as the degree of decolorization obtained.

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[1] This appears to be a fitting place to correct an error which crept into the former summary, and which was pointed out by the author to the writer. The former generously accepts part of the blame, but the writer thinks this unnecessary. Apparently referring to this particular insect, it is stated that *Balclutha mbila* is capable of living "without food" for a considerable period: it should have read "while being artificially fed": None the less, this is a test of its hardy character.—C.A.B.

	Raw melt.	Treated melt.
Brix degrees	64—67	62—64
Quotient of purity	99,0—99,3	99,1—99,3
Invert Sugar	0,20—0,25	0,20—0,25
pH	7,0—7,6	6,8—7,4
Ash	0,08—0,10	0,06—0,08
Lime as CaO	0,010—0,025	0,005—0,020
Surface tension, dyn/cm.	55—59	72—74
Colour on 100°, Brix degrees Stammer	10—15	2—4
Re-treated with 1% Norit	—	0,6—0,8° St.

The nature of the substances (mostly colloidal) removed from the melt can, partly at least, be traced by the analysis of the used "Norit," after it has been freed of sugar by washing it properly with water. Some of the methods of analysis used by us are described hereunder.

(*a*) DETERMINATION OF THE ADSORBED INORGANIC MATTERS (ASH).

A qualitative analysis of these substances has shown most of them to consist of salts of calcium, magnesium, aluminium, and iron, combined principally with sulphuric, phosphoric and carbonic acids. It has often been found that calcium phosphate for example is a substance impeding filtration, as it greatly decreases the rate of flow if present in appreciable amounts.

Normally the average percentage of ash adsorbed after a single application of "Norit" in washed melt strained over wire gauze only is the following (calculated on 100 parts of dry "Norit"):—

	Per cent.
Phosphoric acid, as PO_4	0·21
Sulphuric adid, as SO_4	0·07
Magnesia and lime, as $MgO + CaO$	1·02
Iron and alumina, as $Fe_2O_3 + Al_2O_3$	0·14

The total ash adsorption after a single application of "Norit" is about 1·78 per cent. per 100 parts dry Norit.

(*b*) DETERMINATION OF THE ORGANIC SUBSTANCES.

Investigation was made of the amount of pectins and pentosans, galactans, wax and proteins, the methods of determination used by us being as follows:

1. Pentosans:—20 grms. of dried "Norit" were distilled with 400 c.c. of HCl (sp. gr., 1·09); 300 c.c. of the distillate were collected, 0·1 grm. of phloroglucinol was added and the liquid allowed to settle. Thereafter it was filtered, and the residue dried at 80°C., and weighed.[1]

2. Galactans:—20 grms. dried "Norit" were boiled with 100 c.c. of nitric acid (sp. gr. 1·15) for an hour, after which it was diluted with water, filtered, evaporated down to 20 c.c., and 500 mgr. of mucic acid added. From the increase of weight of the mucic acid the amount of galactose is calculated by the aid of the table of Creydt,[1] by dividing the number given for raffinose by 3. The percentage of galactans is indicated by the amount of galactose found.

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[1] PLUMMER: "Practical Organic and Bio chemistry," 1920, p. 234.

3. *Wax* :—20 grms. of dried "Norit" were extracted in a Soxhlet apparatus with benzene during 10 hours, the solvent evaporated, and the residue obtained weighed. The melting point of this latter was found to vary between 76 and 85°C.

4. *Proteins.*—These were determined by the nitrogen method, according to KJELDAHL, the increase of nitrogen found being multiplied by 6·25 to obtain the amount of protein substances.

Applying the above methods, the following amounts of adsorbed substances were found in the used "Norit," resulting from a single application on washed Cuban melt :—

	Per cent.
Pectins and pentosans	0·78
Galactans	0·50
Wax	0·64
Nitrogenous substances	0·25
Total	2·17 on 100 parts of dry "Norit."

The substances mentioned in the first two groups belong to those which, owing to their strong colloidal character and lyophilic properties, hinder the filtration most. It was found, in general, that the ratio of pectin to "Norit" should not surpass a certain amount if filtration difficulties are to be avoided. In practice this means that for a good quality of raw sugars (Java, for instance) 0·5 per cent. of "Norit" is sufficient for a splendid rate of filtration, whilst for good Cuban sugars 1 per cent. is required; for medium qualities, 1½ per cent.; and for very bad qualities, 2–5 per cent. Experience has shown that with *pH* = 7·3, the ratio may not be greater than one part of "Norit" to 0·045 for a good filtration.

These tests of pectins, pentosans, and galactans give indirectly an idea of the amount in which the several non-sugar substances are contained in the washed melt. But the direct analysis of this melt is very difficult, owing to the small percentages of the impurities in question, which are only about one-fiftieth of the quantities found in the used "Norit."

SURFACE TENSION—ITS MEANING FOR SUGAR-HOUSE WORK.

How the various non-sugar substances affect the surface tension of sugar liquors is not yet completely known. It is, however, probable that it is particularly affected by non-sugar substances of a colloidal nature, especially by proteins.

The surface tension test carried out by us was made by means of Du Noüy's apparatus. The liquor was diluted to 30° Brix, and 50 c.c. was poured into a glass vessel having a liquid surface of 14·5 cm,' the same conditions of working being kept constant for all experiments, an absolute requirement for obtaining comparable results. The liquid was kept immobile during 15 minutes prior to the actual measurements.

For pure sucrose at 20°C. in a 30 per cent. solution: 74·75 dyn./cm. was found; and for pure water under the same conditions: 72·65 dyn./cm. Pure sucrose solutions have thus a somewhat higher surface tension than pure water. As appears from the above given figures, the "Norit" treatment increases the surface tension of the liquor to a value very close to that of pure sucrose, while a filtration using "Filtercel" (kieselguhr of the best quality available) has only a poor result. We found, using 2 per cent. of "Filtercel" on washed Cuban melt, a surface tension before filtration of 58·2, and after "Filtercel" filtration 64·6 dyn./cm.

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[1] LIPPMANN: "Chemie der Zuckerarten, II, p. 1652.

Surface-active substances are inimical to the sugar-man, because: (1) They interfere with the crystallization of granulated, making irregular and mis-shaped crystals; and (2) they are indirectly melassigenic, increasing the time of ripening of the low massecuite.

The advantage of the use of "Norit," as compared with "Filtercel," is thus evident even from the standpoint of pure mechanical filtration. A further advantage as a filtering agent over "Filtercel" is that it decolorizes enormously and is very easily and effectively revivified. It therefore seems difficult to understand why the use of vegetable decolorizing carbons, such as "Norit," as filtering and pre-decolorizing agents, has not met with more interest, than it already has in the sugar industry. It is in every respect superior to kieselguhr, paper pulp or sand.

With regard to further changes in chemical composition, shown by the analytical data, the following has still to be mentioned:

(*a*) *Invert sugars.*—This is generally found by Fehling's solution (lately also the "Luff" test) re-titrating and using Schoorl's tables.[1]

Owing to the short time involved in the decolorizing and filtration process when using "Norit," no substantial change takes place. Generally the invert sugar contents show neither increase nor decrease; special care has, however, to be given to the original acidity of the melt, in order to avoid inversion.

(*b*) *Acidity.*—This determination in sugar liquors is now carried out by the colorimetric method, making use of the Clark and Lubs indicators. In dark solutions the acidity is, however, still determined volumetrically with rosolic acid as indicator.

Should the original acidity of the melt be great, dry, water-free sodium carbonate is used for neutralization. Lime, however, is also often used for the purpose.

(*c*) *Ash.*—This latter is generally determined by the gravimetric method as sulphated ash. Some refineries have introduced the electrical conductivity method and we expect that this will soon be seen in general use.

(*d*) *Lime.*—This is determined by the volumetric method with the aid of soap solution. When using lime to neutralize sugar liquors, care must be taken to use precisely the amount required, any excess being avoided, as this immediately results in a decrease of the quality of the refined sugar produced. If too much lime is present in the melt, use can be made of sodium or ammonium oxalate in order to remove by precipitation part of the excess.

Concluding, we may say that analyses made of the "Norit" used on washed Cuban melt have clearly shown that a considerable amount of non-sugar substances is removed from the sugar liquor by treatment with decolorizing carbon. Owing to this removal, the sugar liquor, after treatment with "Norit," in practice is not only perfectly decolorized, but is also brilliant, and free of such substances as hinder filtration and crystallization and the production of a beautiful white sugar. Sugar liqour obtained after treatment with "Norit" is suitable for the production of all kinds of superior sugars, such as granulated, cubes, or loaf.

Mr. H. T. Easterby,[2] Director of the Queensland Sugar Experiment Stations, gives figures for the cane per acre and sugar per acre during the past 26 years in Queensland, of which the ten-year averages only are here reproduced: 1899-1908, 14·76 and 1·60; 1909-1918, 17·37 and 1·99; 1919-1924, 16·25 and 2·08.

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[1] *Chemische Weekblad*, 1912, 691.

[2] *Australian Sugar Journal*, 1926, 17, No. 10, 624.

The 1925 Java Sugar Crop.

By R. J. PRINSEN GEERLIGS.

During 1925 179 factories were active in Java. The sugar estates planted and harvested an area of 178,290 hectares (439,695 acres) against 172,311 hectares (424,945 acres) in 1924. The total amount of cane harvested was 19,023,897 tons[1] or 43·19 tons to the acre. The total sugar crop amounted to 2,263,479 tons or 11,491 lbs. to the acre. The figures for the different residencies and the totals and averages in tons, lbs. acres, etc., as given below, are calculated after the data published by Mr. J. VAN HARREVELD in the *Archief voor de Java Suiker Industrie.*[2]

The 1925 season proved an excellent one; it had a production of sugar to the acre of 11,491 lbs., as compared with 10,326 lbs. in 1924. The total outturn exceeded to a considerable extent the first estimates, as can be seen in the following figures, being the estimates of production of the members of the United Java Sugar Producers. These estimates, expressed in piculs of 136·16 lbs., were as follows at the dates indicated:—

Date.	Estimate. Piculs.	Date.	Estimate. Piculs.
31st March	29,521,000	31st August	33,151,000
30th April	29,581,000	30th September ..	33,553,000
31st May	30,469,000	31st October	33,620,000
30th June	31,401,000	Final result	33,645,000
31st July	32,406,000		

The average tonnage of cane amounted to 43·19 tons to the acre, which surpasses that of the year 1917 by 0·10 ton to the acre. In 1925 the residency of Kedoe reported the largest figure, followed by Soerabaja, while Pasoeroean was lowest in this respect with only 38·75 tons of cane to the acre.

The sugar content of the cane was very good, allowing an average sugar extraction of 11·88 per cent. The highest extraction was attained in the residency of Djokdjakarta with 13·26 and the lowest in that of Besoeki with 11·20 per cent.

The highest average yield of sugar to the acre is reported from the residency of Kedoe with 13,354 and the lowest in both the residencies of Cheribon and Pasoeroean with 10,326 lbs. The maximum figure for one single factory was witnessed in the residency of Soerabaja, where Kremboong estate scored the highest output of sugar to the acre with 17,308 lbs.

In studying the list of cane varieties planted, it will be seen that there is a marked decrease in the use of B 247, while E K 28 and D I 52 are steadily increasing. The P O J canes have also increased by 3½ per cent., owing to the distribution of the newly cultivated canes such as P O J 2878. The distribution of other available sorts among the plantations remains comparatively unchanged.

The total sugar crop amounted to 2,263,479 tons, of which 2,205,201 tons were first sugars, and the balance consisted of after-products, calculated back to the equivalent of first runnings in the ratio of 4 : 3. The figures in the second column of Table III refer, however, to the real weight. Besides the sugar, a quantity of 71,679 tons of solidified molasses was manufactured and exported.

In Table IV we see an increase in the proportion of the first running white plantation sugar and of refining crystals of 96·5° pol.; on the other hand the Channel assortment refining crystals of 98°pol. decreased by the same amount.

The data following now, concerning the figures for the factory work, have been derived from the statistics annually issued by the Chemical Department of the Java Sugar Experimental Station; but whereas the foregoing figures referred to every one of the 179 factories, the technical data relate only to 165 establishments, viz., those subscribing to the station. As these are the best controlled factories, it is probable that the figures, recording the work done in them, are better than the total average of the 179, that worked in 1925, although one does not believe the difference to be large.

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[1] Tons of 2240 lbs.

[2] *Mededeelingen van het Proefstation voor de Java Suiker Industrie*, 1926, No. 4.

Next to the list of averages, we give here a few maxima and minima, relating to the results of the entire grinding season in the individual factories. We have not added the names, as these are unnecessary.

	Maximum.		Minimum.	
	1924.	1925.	1924.	1925.
Sucrose in cane	15.00	16.20	11.10	11.90
Fibre in cane	17.90	17.90	10.20	10.20
Sucrose in bagasse	5.60	5.80	2.10	1.80
Moisture in bagasse	50,70	49.50	41.10	41.40
Sucrose in filter-press mud (defecation)	10.40	10.50	0.50	0.60
Sucrose in filter-press mud (carbonation)	1.90	3.20	0.20	0.10
Purity of raw juice	87.40	89.10	76.30	77.70
Purity of final molasses	33.50	35.60	25.10	23.80
Sucrose in juice on 100 cane	14.24	15.36	10.28	10.99
Calculated available sugar on 100 cane	13.86	15.14	9.13	10.19
Sugar extracted on 100 cane	13.73	14.99	9.03	10.05

The sugar content of the cane was very good, while the purity of the raw juice was good though not superior. As the extraction of the juice by the mills was very satisfactory, the amount of sucrose extracted in juice on 100 cane (being 13·08 per cent. on an average) was higher than in the preceeding 11 years. The same thing was also observed for the calculated available sugar, which was 12·45 per cent., of which in reality 12·38 was extracted. The quotient of purity of the exhausted molasses was the same as in 1924 (30·5 per cent.) ; the figure for the loss of sucrose in molasses was also about the same. In general, the work done in the sugar-house was of a good standard, both in respect of the milling work and the working up of the juice.

We also give here the data, relating to the total sales of Java sugar and the portion sold by the United Java Sugar Producers, which body, according to these figures, disposed of 89·9 per cent. of the total Java crop of the year 1925.

ASSORTMENTS.	TOTAL SALES PICULS.	SALES BY U.J.S.P. PICULS.
Superior " head " sugar	21,223,431	19,676,780
Superior soft sugar	208,193	267,770
Channel assortment 98° pol.	6,937,790	5,569,394
Raw sugar 96.5° pol.	7,905,543	7,672,762
Molasses sugar	1.209,710	507,881
Bag sugar	71,535	5,000
Total sales	37,556,202	33,751,780

All these figures represent piculs of 61·76 kg. or 136·16 lbs.

The United Java Sugar Producers had begun their sales of the 1925 crop in the first half of the year 1924, and up to the first of July they sold more than 6,000,000 piculs, and continued selling at declining prices till they had sold at the end of February, 1925, 28,000,000 piculs at an average price of 11·97 guilders for the whites. In the month of November, 1925 all of the crop had been disposed of at an average price of 11·37 guilders per picul of whites, 10·90 per picul of refining crystals basis 98° pol., and 10·23 for the sugar basis 96·5° pol.

We estimate the consumption in the territory of the Dutch East Indies at 150,000 tons or 2,400,000 piculs, while the balance is disposable for export.

I.—CANE CROP.

Residencies and Totals.	Number of Factories.	Land under Cane.		Cane Harvested.		
		Hectares.	Acres.	Tons.	Tons per Acre.	Kg. per Hectare.
Cheribon	12	11.073	27.307	1.076.506	39.48	99,133
Pekalongan	17	17,206	42,432	2,017,450	47.28	118,716
Banjoemas	5	5,767	14,222	661,020	46.45	116,627
Kedoe	2	4,199	10,356	508,740	49.01	123,067
Djokdjakarta	17	16,594	40,924	1,724,304	42.08	105,660
Soerakarta	16	17,868	44,067	1,759,082	39.87	100,090
Semarang	11	10,479	25,842	1,105,472	42.74	107,314
Madioen	6	8,156	20,115	865,306	42 91	107,749
Kediri	21	24,749	61,037	2,620,403	42.53	106,792
Soerabaja	36	28,627	70,599	3,350,534	47.49	119,238
Pasoeroean	27	26,651	65,727	2,540,696	38.75	97,305
Besoeki	9	6,921	17,067	794,384	46.42	116,540
Total **1925**	**179**	**178,290**	**439,695**	**19,023,897**	**43.19**	**108,446**
1924	179	172,311	424,945	18,029,702	42.36	106,357
1923	179	162,481	401,485	16,078,051	40.04	99,986
1922	182	160,908	397,443	16,759,106	42.05	105,816
1921	183	159,474	394,060	14,939,679	37.89	95,125
1920	183	156,069	385,647	14,398,238	37.34	93,732
1919	179	137,655	340,138	13,075,128	38.10	96,517
1918	186	163,071	402,943	15,637,342	38.44	97,387
1917	185	160,439	396,440	17,079,303	43.09	108,179
1916	186	155,165	385,290	15,878,300	41.11	103,218
1915	186	151,165	373,500	14,189,000	37.97	96,385
1914	186	147,465	366,000	14,901,000	40.87	102,000

II.—SUGAR EXTRACTED.

Residencies and Averages.	Kg. per Hectare.	Lbs. per Acre.	On 100 Cane.	Yearly maximum output of any single factory.	
				Kg. per Hectare.	Lbs. per Acre.
Cheribon	11,576	10,326	11.68	13,671	12,196
Pekalongan	13,316	11,878	11.22	15,464	13,793
Banjoemas	13,926	12,423	11.94	16,491	14,712
Kedoe	14,970	13,354	12.16	17,023	15,187
Djokdjakarta	14,013	12.499	13.26	17,580	15,684
Soerakarta	12,446	11,101	12.43	17,814	15,886
Semarang	12,185	10,870	11.35	16,605	14,813
Madioen	12,533	11,179	11.63	13,838	12,344
Kediri	12,968	11,567	12.14	16,022	14,293
Soerabaja	13,752	12,266	11.53	19,399	17,308
Pasoeroean	11,576	10,326	11.90	16,100	14,362
Besoeki	13,055	11,645	11.20	15,743	14,044
Average 1925	**12,881**	**11,491**	**11.88**	**19,399**	**17,308**
,, 1924	11,582	10,326	10.88	18,015	16,097
,, 1923	10,965	9,784	10.97	16,362	14,480
,, 1922	11,226	9,950	10.61	16,362	14,480
,, 1921	10,517	9,321	11.04	17,911	15.875
,, 1920	9,892	8,826	10.55	15,178	13,540
,, 1919	9,706	8,657	10.06	14,639	12,957
,, 1918	10,904	9,723	11.19	15,996	14,265
,, 1917	11,382	10,117	10.50	16,415	14,696
,, 1916	10,355	9,238	10.03	15,300	13,650
,, 1915	8,729	7,788	9.15	12,941	11,546
,, 1914	9.526	8.495	9.28	14.125	12.602

III.—SUGAR PRODUCTION IN TONS.

Residencies and Totals	First Sugars.	After Products.	Total Production After-products as 4 : 3.	Solidified Molasses.
Cheribon	123,459	2,799	125,353	2,153
Pekalongan	221,741	6,651	226,743	17,038
Banjoemas	79,063	102	79,142	1,002
Kedoe	61,827	173	61,961	3,570
Djokdjakarta	227,463	1,882	228,876	—
Soerakarta	217,851	778	218,438	—
Semarang	122,841	4,023	125,861	6,316
Madioen	99,111	1,783	100,452	—
Kediri	306,179	16,456	318,544	1,347
Soerabaja	381,095	7,249	386,585	18,952
Pasoeroean	276,876	34,257	302,528	10,741
Besoeki	87,695	1,723	88,996	10,560
Total, **1925**	**2,205,201**	**77,876**	**2,263,479**	**71,679**
„ 1924	1,924,942	54,427	1.966,237	82,504
„ 1923	1,740,895	31,655	1,764,636	103,842
„ 1922	1,749,640	39,609	1,779,557	62,125
„ 1921	1,632,067	34,620	1,658,032	74,892
„ 1920	1,497,244	30,060	1,519,562	164,459
„ 1919	1.297,320	23,977	1,315,158	96,303
„ 1918	1,714,833	101,922	1,750,197	18,511
„ 1917	1,779,654	22,682	1,793,415	49,870
„ 1916	1,579,670	32,300	1,604,154	85,749
„ 1915	1,273,190	35,312	1,298,307	127,543
„ 1914	1,305,246	100,061	1,382.825	94,765

IV.—SUBDIVISION OF THE CROP IN PERCENTAGES ACCORDING TO ASSORTMENTS.

Residencies and Averages.	Plantation White Sugar.		Channel Assortment Refining Crystals, 98° pol.				
	First running.	Second running.	First running.	Second running.	Refining Crystals, 96·5° Pol.	After-products.	Total.
Cheribon	62 90	1.00	12.60	—	21.60	1.90	100
Pekalongan	69.90	3.80	8.50	—	15.40	2.40	100
Banjoemas	—	—	40.20	—	59.60	0.20	100
Kedoe	—	—	47.00	—	52.70	0.30	100
Djokdjakarta	75.00	0.40	8.20	—	15.60	0.80	100
Soerakarta	90.10	—	4.50	—	5.00	0.40	100
Semarang	44.60	1.20	25.20	—	26 40	2.60	100
Madioen	98.40	—	—	0.10	—	1.50	100
Kediri	67.60	—	14.50	0.40	13.50	4.00	100
Soerabaja	62.30	—	21.90	0.60	13.60	1.60	100
Pasoeroean	23.90	—	27.50	0.20	39.70	8.70	100
Besoeki	—	—	51.00	—	47.40	1.60	100
Average, **1925**	**56.99**	**0.55**	**18.42**	**0.20**	**21.23**	**2.61**	**100**
„ 1924	54.45	0.99	25 69		16.78	2.09	100
„ 1923	53.11	1.06	28.91		15.20	1.72	100
„ 1922	52.85	1.53	27.45		16.46	1.71	100
„ 1921	53.42	0.12	28.05		15.33	3.08	100
„ 1920	51.71	0.83	30.41		15.08	1.97	100
„ 1919	49.70	2.10	23.10		23.30	1.80	100
„ 1918	45.90	3.20	27.00		21.00	2.90	100
„ 1917	50.30	1.90	40.60		6.20	1.00	100
„ 1916	48.10	2.90	37.30		9.70	2.90	100
„ 1915	43.80	4.20	34.90		14.10	3.00	100
„ 1914	40.30	4.00	32.30		15.70	7.70	100

V.—PERCENTAGE COMPOSITION OF THE CANE PLANTINGS OF—

VARIETY.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925*
B 247	48	41	29	26	20½	17¼	15½	12½	4¾
POJ 100	31	28	16	10	6½	4	2¾	1½	7½*
Cheribon	4	3	1	1	½	—	—	—	—
POJ 213	1	1	—	—	½	—	—	—	—
EK 2	4	4	6	6	6½	6½	6	6¼	5
EK 28	2	6	23	32	39	39	40	43½	44
F 90	2	4	4	3	3	3¼	3	3	2½
DI 52	1	4	13	14	15	18½	21½	22½	27¾
Tjep 24	—	2	1	1	1	—	—	—	—
SW 3	—	1	1	2	2	2½	2¾	3	3
POJ 2714	—	—	—	—	—	2	2¾	2¼	—
POJ 2725	—	—	—	—	—	1½	1	½	—
Various	7	6	6	5	5½	5½	4¾	5	5½
Total	100	100	100	100	100	100	100	100	100

* This number represents all varieties of POJ canes.

VI.—FACTORY RESULTS DURING THE LAST DECADE.

CANE—	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Sucrose	12.42	12.82	13.63	12.38	12.94	13.41	12.87	13.06	13.10	13.90
Fibre	13.14	13.02	12.99	13.01	12.98	12.98	13.19	13.14	12.90	12.80
BAGASSE—										
Sucrose	4.00	4.10	4.34	4.03	4.07	4.12	3.85	3.75	3.60	3.30
Moisture	46.97	46.82	47.22	47.01	46.76	46.43	46.30	46.49	46.30	45.50
SUCROSE EXTRACTED BY MILLS	91.10	92.30	92.10	92 00	92.50	92.50	92.90	92.20	92.80	93.90
SUCROSE IN FILTER-PRESS CAKES	4.51	4.15	4.36	3.70	3.75	3.81	3.55	3.20	4.10	3.80
SUCROSE IN JUICE PER 100 CANE	11.32	11.83	12.55	11.39	11.97	12.41	11.96	12.04	12.17	13.08
PURITY OF RAW JUICE	84.41	85.80	86.50	83.70	85.40	85.30	84.60	84.60	83.70	84.00
PURITY OF FINAL MOLASSES	32.40	32.60	33.10	32.10	32.20	32.40	32 00	31.30	30.50	30.50
CALCULATED AVAILABLE SUGAR	10.80	11.40	12.17	10.60	11.31	11.73	11.23	11.51	11.51	12.45
SUGAR EXTRACTED PER 100 CANE	10.42	11.00	11.68	10.44	11.13	11.51	11.08	11.43	11.44	12.38
SUCROSE TURNED OUT PER 100 OF :—										
Cane	10.06	10.48	11.27	10.12	10.64	11.00	10.60	10.92	10.92	11.82
Sucrose in cane	81.00	81.75	82.61	81.66	82.23	82.67	82.36	83.10	83.35	85.03
Sucrose in juice	88.90	88.58	89.80	88.85	88.90	80.60	88.34	90.71	89.80	90.40
SUCROSE LOST PER 100 OF :—										
Cane	2.36	2.34	2.36	2.26	2.30	2.41	2,27	2.14	2.18	2.08
Sucrose in cane	19.00	18.25	17.29	18.34	17.77	18.12	17.64	16.90	16.65	14.97
Sucrose in juice	11.10	11.42	10.20	11.15	11.10	11.40	11.35	9.29	10.20	9.60
LOST IN BAGASSE PER 100 OF :—										
Cane	1.10	0.99	1.08	0.99	0.97	1.00	0.91	1.02	0.93	0.85
Sucrose in cane	8.86	7.72	7.92	7.99	7.50	7.46	7.07	7.77	7.10	6.10
LOST IN FILTER-PRESS CAKES PER 100 OF :—										
Cane	0.10	0.09	0.10	0.09	0.10	0.10	0.09	0.09	0.07	0.07
Sucrose in cane	0.80	0.74	0.73	0.73	0.77	0.75	0.70	0.69	0 50	0.50
Sucrose in juice	0.88	0.80	0.80	0.79	0.80	0.81	0.75	0.72	0.60	0.50
LOST IN MOLASSES PER 100 OF :—										
Cane	0.85	0.91	0.94	0.90	0.93	1.01	0.98	0.80	0.90	0.92
Sucrose in cane	6.84	7.11	6.95	7.27	7.11	7.16	7.62	6.09	6.90	6.60
Sucrose in juice	7.59	7.70	7.50	7.90	7.80	7.74	8.17	6.65	7.50	7.10
UNACCOUNTABLE LOSSES PER 100 OF :—										
Cane	0.36	0.35	0.24	0.28	0.30	0.30	0.29	0.28	0.28	0.24
Sucrose in cane	2.50	2.68	2.17	2.35	2.39	2.75	2.25	2.35	2.15	1.77
Sucrose in juice	2.66	2.92	2.54	2.46	2.50	2.86	2.48	1.92	2.10	2.00

The 1925 Java Sugar Crop.

The destination of the exports of the year 1925 has been as below in metric tons; and we give the corresponding figures for a few previous years as a comparison. The stocks of sugar still existent at the beginning of the 1925 grinding season are estimated at none and on the 30th April, 1926, at 17,157 tons.

EXPORTATION OF JAVA SUGAR IN METRIC TONS.

DESTINATION.	1923.	1924.	1925.
Netherlands	9,680	17,126	18,329
Belgium	5,502	11,628	13,540
United Kingdom	186,756	100,235	23,501
France	107,726	114,151	29,352
Germany	359	2,596	5,910
Russia and Finland	——	33,911	26,278
Denmark	——	——	1,322
Norway	732	2,467	560
Italy	8,593	4,900	35
Portugal	——	1,017	3,255
Greece	21,116	16,795	21,521
Gibraltar f.o.	16,729	509	——
Other European States	7,122	925	1,933
Canada	32,830	18,242	——
United States	3,133	4,919	——
Port Said, f.o.	191,416	152,569	105,793
Turkey f.o.	2,624	1,272	3,915
Arabia	1,280	3,898	3,878
British East Africa	——	——	331
British India	506,589	538,615	755,762
Penang	11,664	15.798	18,258
Singapore	61,025	74,879	91,600
Siam	10,880	16,392	41,509
French Indo-China	101	——	1,629
Hong Kong	285,717	313,955	216,921
China	24,121	86,249	232,558
Japan and Formosa	301,942	332.808	432,914
Australia	23,729	8,808	——
New Zealand	928	1,325	41
Other countries	2,355	5,981	335
Total	1,824,649	1,881,970	2,050,980

The 1925-26 sugar season in Czecho-Slovakia resulted in 8,825,000 metric tons of roots being worked, an increase of 600,000 tons as compared with the previous season. Sugar production amounted to 1,481,000 metric tons, an increase of 5⅛ per cent. over 1924. Sugar export from last October to the end of February amounted to 541,000 tons or 93,000 tons less than the exports for the same period in 1924-25; this left 500,000 tons for further export. The production of molasses at the end of March had amounted to 262,000 tons, an increase of 27,000 tons.

Some difficulty has been experienced in bleaching cane wax.[1] One method is to steam at 120°C. for six hours, or better to melt it over a solution of 1 per cent. of potassium chlorate and 2-5 per cent. of sulphuric acid, air being blown through for several hours, after which it is treated with bleaching powder.[2] But best of all for obtaining the wax in a pure state with an m.p. above 80°C., and with a good colour, is to crystallize it out from petroleum ether, then bleach with chlorine.

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[1] *The Chemical Trade Journal*, May 28th, 1926. [2] U.K. Patent, 50,666.

Notes on *Milling* Practice, Chicama Factory, Cartavio, Peru.

By W. O. DUNCAN, late Chief Engineer, Chicama.

Chicama factory is the second largest in Peru, and in 1924 ground over 390,000 metric tons of cane, this making about 16 per cent. of the total sugar production of Peru.

The milling plant consists of one 1913 tandem, 34 in. × 78 in., with 12 rollers and a single crusher, preceded by two sets of revolving cane knives or levellers, and one 1921 tandem, 34 in. × 78 in., with 15 rollers and a double crusher, also preceded by two sets of cane knives.

The grinding season lasts from 10 to 12 months of the year. The cane is practically all burned in the fields previous to cutting, and is cut in one piece the full length of the cane. It arrives at the factory in this state, cross loaded on 10-ton open railway cars.

At the factory the cars are weighed, and drawn over the cane carrier and under the unloaders or cane rakes by electric winches on two tracks passing at right angles to and over the carrier. Two sets of Gregg type cane rakes are placed over each carrier and run parallel to and discharge the cane directly into the carrier.

To facilitate the unloading of this long and usually bent and twisted cane, the usual straight fingers on the unloader are replaced by hooks or claws, and one rake can discharge 65 tons of cane per hour when necessary.

Any unevenness of cane in the carrier after leaving the unloaders is taken out by the two sets of cane knives, which work more as levellers than cane cutters. The first set of knives has a clearance of 36 in. from the carrier, and the second set 18 in. or less. These levellers consist of 16 double-ended knives or 32 cutters, which was found ample, running at 200 r.p.m. and driven by 50 h.p. electric motors.

The cane in the inclined carrier, which is driven by an independent steam engine, after passing the levelling knives arrives at the crusher as a very even feed, and the carrier operator has little difficulty in giving the crusher and incidentally the mills a steady feed, which, in fact, is absolutely necessary, and should start right from the first crusher if good work is to be got from the tandem as a whole.

On the mills all feed rollers are Messchaert grooved, and also the last roll in each tandem. These grooves are made about $\frac{3}{16}$ in. wide by about 1¾ in. deep, and gradually get wider as the roll gets worn. Only one set of groove scrapers is used for each roll, but care must be taken to keep the grooves clear or the feeding of the mill will be upset, and extraction lowered.

Surface grooving of rollers is at 3 per 1 in., 2½ per 1 in., 2 per 1 in., and ¾ in. pitch, the finer grooving on the last mill in the tandem, and the coarse on the first mill. The angle of grooving is 45 to 55°. The surface grooving in any mill is made to mesh. As far as possible, new large diameter rollers were used in the last mill of the tandem, rolls of 35 in. diam. being got for this, and replaced and moved forward as they became smaller. Rolls less than 33 in. were usually discarded. In each mill the rollers were the same diameter as nearly as possible, although a difference of ½ in. did not matter. Hydraulic pressures up to 500 tons were applied to the top rolls, with 100 tons less on those mills receiving the cush-cush, which in the older tandem is the fourth mill, and on the newer tandem at the second and fourth mills. Cush-cush is handled by slat and screw conveyors.

Much skill and close supervision is necessary to get good results, and roll and trash-plate settings and the selection of suitable Messchaert grooving require care and experience, which latter can be acquired only by long and careful acquaintance with the mill and its characteristics, combined with never-failing close supervision.

The milling capacity being ample for the rate at which the cane is delivered to the factory, high sucrose extractions can be expected. It is sometimes only necessary to run one tandem for part of the year. The compound system of maceration is used and the intermediate carriers are of the slat type.

The following data give the highest extractions ever obtained at Chicama for periods of six months and one year. Much higher tonnage rates have been obtained than those shown. An average of 67 metric tons per hour, for example, has been done, over a period of about six months, on the smaller tandem with an extraction of sucrose per cent. sucrose in cane of 96·0. And on the larger tandem over 80 metric tons per hour have been ground with a sucrose extraction of 97 per cent.

Highest Extractions.

Period.	Per cent. Sucrose in cane.	Per cent. Fibre in cane.	Maceration per cent. cane.	Per cent. water in Bagasse.	Tons (Metric) Cane per hour	Extraction Sucrose Per cent. Sucrose in cane.
One year average, Two Tandems, Jan. to Dec., 1923.	14.43	14.62	24.16	43.98	77.27	97 12
Six months' average, Big Tandem, Jan. to June, 1924.	14.21	15.06	22.04	43.99	65.98	97.28
Six months' average, Small Tandem, Sept. 1923 to Feb. 1924.	14.28	14.74	24.73	—	39.97	96.89

For controlling individual mill performances, occasional tests made on the bagasse coming from each gave these figures:—

Per cent. Sucrose in cane.	Per cent. Fibre in cane.	Sucrose Extraction.	Per cent. Sucrose in Bagasse behind Mill.				
			1	2	3	4	5
14.13	15.8	97.2	—	4.98	3.54	2.37	1.38

Drs. Samuel A. Leirne, Burgess Girdon, and Clifford L. Derick[1], as the result of studying the metabolism of Marathon runners at the finish of a particularly gruelling race, observed among other changes that there appeared to be a close correlation between the condition of the runner and the level of his blood sugar, those with a low blood sugar content presenting a picture of shock. They suggest, in consequence, that the adequate ingestion of carbohydrate before and during any prolonged violent muscular effort would be of considerable benefit in preventing the hypoglycemia, and symptoms of exhaustion accompanying it.

Dr. Herbert Levenstein,[2] speaking recently at Manchester on the importance of establishing a national chemical intelligence service, pointed out that Patart patented his process of converting water-gas into methyl alcohol (on which principle carbonaceous matter will probably be converted with good yield into alcohol motor fuel) in France only,[3] and that as soon as his specification was published the Badische Anilin & Soda Fabrik at once examined the method, quickly surrounding it with a network of patents on their own. Methyl alcohol is now being made by the B. A. & S. F. patents on a large scale at a very low cost indeed.

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[1] *W.I. Committee Circular*, January 14th, 1926, page 7.

[2] *Chemical Trade Journal*, 1926, 78, No. 2019, 125-127. [3] *I.S.J.*, 1926, 79.

Report on Boiler-House Plant in Hawaii.[1]

By J. LEWIS RENTON.

ELIMINATION OF OIL IN BOILERS.

GEORGE DUNCAN, of Olaa, has contributed the following: The cost of the necessary apparatus for the successful elimination of oil from boilers is infinitesimal when compared with the cost of repairs to them due to the presence of oil. Oil adheres to the heating surface and forms a coating, which acts as an insulator and reduces the transmission. When the boilers are being worked at or near their capacity, overheating of the heating surface takes place with consequent bagging and possible rupture of the tubes and plates.

Some separate the oil from the steam before it goes to the evaporators, vacuum pans, etc.; some attempt to remove it from the feed-water after leaving the hot-well; and others make little or no attempt to remove it at all. The logical method would therefore be the first. There are various types of devices for separating the oil from the steam, but a very efficient one is built locally. It consists of a horizontal steel drum closed at both ends, about 3 ft. 6 in. diam. and about 8 ft. long. The inlet opening is in the centre of one of the heads, the outlet being at the other end but through the shell, on the top. Inside the drum is a deeply ribbed cast-iron plate, placed 6 in. in front of the inlet, open at the sides and bottom, but closed at the top. Entering exhaust steam impinges against the ribbed plate, and passes to the outlet, through the openings between the shell and sides of the plate. The ribs of the plate, being at right angles to the direction of flow of the steam in its passage from the inlet to the openings between the shell and plate, act as retainers for the oil collecting on the plate, until it drains to the bottom of the drum, from whence it is drawn off by a 2 in. pipe at the outlet end. This apparatus does all that is claimed for it.

Extracting the oil from the boiler feed-water after leaving the hot-well is done by feed-water filters. Two seem to predominate: one in which excelsior is the filtering medium, the other in which Terry cloth or Turkish towelling is used. They may do the work that is claimed for them, but as the filtering medium has to be removed and cleaned at least once a week, the cost of their operation is high in comparison with the steam separator, which requires no attention whatsoever except to see that the drain pipe is kept open.

It has been observed at the cleaning of a feed-water filter, connected to the surface condenser of a steam engine, that not 20 per cent. of the cylinder oil fed to the engine was to be found on the filtering cloth. It must therefore be assumed that a large portion of the oil found its way through the cloth and incidentally into the boilers.

There is no doubt that the ideal installation would be an oil separator, placed ahead of the boiling and evaporating apparatus, and a feed-wator filter in the feed line. In that case it would be practically impossible for any oil ever to find its way into the boilers. The quality of cylinder oil to be used in a sugar factory is an important question. As has been proved, more than 50 per cent. saving in the consumption of oil can be obtained by the use of a high grade quality, than can be by the use of one at half that price.

A. W. DUNN states that the system now in operation at Honomu prevents lubricating oils from entering boilers and keeps the heating surfaces free from oil, as the greasy condensates are taken into a counter-current surface condenser and utilized as heating agents to raise the temperature of the fresh water supply or "make-up." There has thus been provided a very simple arrangement whereby oily condensates are exchanged for an uncontaminated feed-water supply without material loss of temperature in the feed-water entering boilers. This system has been in operation for the past seven months, and, at the close of the grinding season, the boiler inspector reported boilers free from oil.

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[1] Abridged from Reports of the Association of Hawaiian Sugar Technologists, October, 1925.

BOILER ROOM.

There always has been and still is considerable discussion on the question of rating for a boiler, but the writer has always taken 10 sq. ft. of boiler heating surface for one boiler horse power. This is done for two reasons: (1) it gives the approximate heating surface immediately by adding one cipher; and the heating surface is a reliable factor of size; (2) it has been found that for most boilers the best results are obtained with an evaporation of about 3·5 lbs. of water from and at 212°F. per sq. ft. of heating surface per hour, which corresponds very closely to 10 sq. ft. of heating surface per boiler horse power.

The rating has nothing to do with developed horse power, as an evaporation of 10 lbs. of water per sq. ft. of heating surface per hour can be attained, which will result in about 3½ sq. ft. of heating surface per boiler horse power. It is also possible to go to the other extreme and have excessive heating surface. This is sometimes advisable where considerations governing the installation make it desirable to combine the heating surface of a boiler and economizer in one unit, this unit performing the function of both.

It is customary to assume a uniform heat transmission for the entire exposed heating surface. Each square foot of heating surface is then capable of transmitting a certain amount of heat, depending on the conductivity of the material, the character of the surface, the temperature difference between the gases and the water, the location and arrangement of the tubes, the density of the air, the velocity of the gas, and the time allowed for transmission of the heat.

NÖEL DEERR[1] observed in this connexion: "I have always held that economy in combustion is obtained in the furnace and that the boiler plays a comparatively small part in fuel economy. Water-tube boilers are, however, made in units of much larger dimensions than the return tubular boilers, hence for a given heating surface in the boiler there is less exposed radiating surface with the water-tube boiler than with the return tubular boiler."

There are two other important considerations in the attainment of rating in a bagasse boiler—as compared with coal and oil-fired boilers—and these are lack of absorption by direct radiation to boiler from the combustion chamber and the lower gas temperatures. In this respect, the bagasse boiler is about in the same class as the wood waste fuel boiler and better off than the waste heat installation.

"Steam," published by the Babcock & Wilcox Co., informs us as follows: "In direct-fired coal or oil-fired practice, where furnace temperatures of from 2400 to 2800°F. are commonly developed, the amount of heat absorbed by direct radiation from the furnace represents a very large percentage of the total heat absorbed by the boiler. If the results of direct-fired boilers and waste-heat boilers are to be compared from the standpoint of total heat absorbed as measured by steam output, the increased absorption through radiation in the direct-fired boiler must be offset by a corresponding increase in absorption by convection in the waste-heat unit over that absorbed by convection in the direct-fired boiler. For high rates of convection absorption, high rates of heat transfer are essential, and such transfer rates necessitate high gas velocities. For boilers developing approximate rating in the two classes of work, with waste gas temperature of from 1200 to 1300°

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[1] *Record*, 1, 106.

entering, and the arrangement of direct-fired boiler surface ordinarily found in stoker-fired work, the velocity of gas through the waste-heat unit is probably slightly more than three times that through the direct-fired boiler."

There are tests on record showing waste-heat boilers developing considerably over rating with temperatures of gas at 1700 to 2100°F., which is certainly no better than bagasse boiler work.

This would lead one to believe that the so-called high type of boiler, or one that is narrow for its particular H.P. rating, would lend itself to our conditions on account of the high velocity of gases. This would be so provided that the necessary grate area could be accommodated without too much expense or too much lost heat by increased radiating surface.

The following table is presented to show the differences that probably exist in bagasse-fired and coal-fired boilers:

	COAL	BAGASSE.
B. T. U. per lb. of dry fuel	12,825	8,350
B. T. U. per lb. of fuel as burnt	12,248	5,010
B. T. U. lost in flue gases at 500°F.	2,408	1,635
B. T. U. available for useful work	9,840	3,375
Temperature of combustion	2,746	2,156
Cub. ft. of flue gases, 500°F.	459	198
Lbs. bagasse equal to 1 lb. of coal	—	2·92
Cub. ft. of flue gases from 2·92 lbs. bagasse	—	578

This shows that it takes 2·92 lbs. of bagasse to equal a pound of coal, the temperature of combustion is lower and the volume of gases is 39 per cent. greater, when considering the same available heat.

It is considered good practice to assume 5 lbs. of coal per B.H.P. at 150 per cent. rating; this gives 3·33 lbs. per B.H.P. This corresponds to 9·73 (3·33 × 2·92) lbs. of bagasse per B.H.P. at rating. This figure of 9·73 checks very closely with actual experiments in Hawaii.

As far, then, as boilers themselves are concerned, there is no valid reason why rating, or more than rating, can not be attained, provided the necessary heat units are supplied to the boiler from the furnace.

GRATES.

The function of the grate is to furnish, with as little loss as possible, sufficient combustion to furnish the required hot gases to attain the boiler rating, previously decided upon, as desirable. The amount of draft has quite an effect on the amount of bagasse than can be burnt per sq. ft. of grate area per hour. Oahu Sugar Company, Ltd., can get 125 to 150 rating out of their boilers with 0·077 sq. ft. of grate per B.H.P., while at Ewa we employ 0·215 sq. ft. for the same results, and the new boiler installations at Waimanalo have about 0·170.

It would seen reasonable to suppose that the amount of bagasse burnt per sq. ft. of heating surface per hour in all three cases should be about the same. We can assume that 1 lb. of bagasse is required per sq. ft. of H.S. per hour. This checks very closely with the figure derived in the previous computations, which is 0·975 lb. per sq. ft. H.S. (or 9·75 lbs. per B.H.P.).

The lbs. of bagasse per sq. ft. of grate surface per hour at 125 per cent. boiler rating for the three installations mentioned are:—

Oahu—163 Waimanalo—75 Ewa—58.

The Honolulu Iron Works Company have been kind enough to furnish the following information on 14 Stirling boiler installations of their design. Assuming 100 per cent. rating, and 1 lb. of bagasse per sq. ft. heating surface, the lbs.

of bagasse burnt per sq. ft. of grate area per hour vary from 70 to 96, with an average of 81. Taking arbitrary ratings from 90 to 120 of full rating load, we find :—

Per cent. rating	90	100	110	120
Lbs. bagasse per sq. ft. G.A. per hour	73	81	89	99

Admitting that these are all assumptions, they are not very far off, as there is no logical reason why the amount of bagasse burnt per sq. ft. of boiler heating surface per hour should vary greatly. If there is any great variation, it is an indication that the furnace design is faulty, provided the moisture in bagasse is fairly uniform. The deduction then is, that for the amount of draft encountered on most plantations, the lbs. of bagasse per sq. ft. of grate area for Stirling boilers is about 75 lbs. instead of 100 to 125 as usually understood.

It is interesting to note in this connexion, that the Kennedy Patent Furnace increased the output of the boiler considerably above rating. This was an increase in rate area and furnace volume only, and neglecting the furnace would tend to indicate that increased grate surface alone was what was needed. Since the draft was not changed and the flues and stack were able to handle the increased volume of gases evolved, this would eliminate draft as the important factor and again stress the importance of grate area. The furnaces for these boilers were originally laid out after the Hawaiian practice, and, following in our footsteps, failed to develop the rating desired. Assuming 1·2 lbs. bagasse per sq. ft. H.S. per hour, we have the following lbs. of bagasse per sq. ft. G.A. :

100% rating—58, 125% rating—72·5, 150% rating—87·5, 175% rating—99·5.

It is believed that, at least for Hawaiian conditions, the step grate has certain advantages over the so-called flat grate of Cuba. One of the very important factors for complete combustion with a minimum of excess air is to bring the combustible, whether in a solid or gaseous state, into intimate contact with the available oxygen in the air drawn into the furnace. It would appear then that the step grate, drawing a good part of the air for supporting combustion through the fuel bed of practically uniform thickness, would have a much better chance for combustion with a minimum of excess air than the furnace with a burning cone of bagasse, and introducing air on all sides of the cone through openings in the furnace, or around the edges of the cone.

The big lumber mills used to dump their wood refuse on flat grates, but are now building elaborate furnaces. They are having just as good results with the step grate as with flat grate construction.[1] The tendency in the Philippines is to have very steep step grates (about 60° from the horizontal) and install 3 or 4 ft. bottom grates. The moisture content of Cuban bagasse is in the neighbourhood of 48 to 50 per cent. and in the Philippines about 47 per cent. This may have an important bearing on the type of grate needed.

FURNACES.

The ideal furnace is that which will completely consume the combustible with the least surplus air. To obtain this result, the furnace temperature should be the maximum that can be maintained, and combustion should be complete within the furnace. There is nothing new in this, as A. GARTLEY, in 1918, pointed out that " for efficient combustion it is essential that a high temperature be obtained in the furnace, that products of combustion have as high a per cent. of CO$_2$ as possible, and that the stack temperature be low."

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[1] See *A.S.M.E. Journal*, July, 1925.

Complete combustion with the *least surplus* will give *maximum temperatures* and the nearest apppoach to the ideal possible. Each of these three main factors has such a bearing on the net result that we will discuss them separately, with respect to their bearing on furnace design.

The maximum temperature that can be maintained in any furnace under present approved furnace construction is about 2200°F. to 2400°F. when loaded to 20 lbs. to the sq. in. Reducing the allowable load to 10 lbs. per sq. in. will increase the permissible temperature about 200°F. It is necessary to keep down the furnace temperature in coal and oil burning furnaces by placing the boiler directly over the burning fuel and letting the boiler absorb some of the heat of combustion by radiation. With bagasse, this is not necessary. Therefore, any furnace that is so designed that there is no intervening wall between the fuel bed and the boiler is taking chances, because, if there is a lowering of the temperature below the point where combustion is supported, losses will occur. The temperature of combustion, for various moisture content of bagasse and variable amounts of excess air, is :—

Temperatures of Combustion.

Excess Air.	Moisture of Bagasse Per Cent. 36	38	40	42	44	46	50
50	2756	2731	2677	2621	2591	2527	2436
75	2452	2433	2366	2340	2317	2263	2187
100	2211	2196	2156	2116	2097	2050	1985
125	2013	2007	1967	1931	1916	1875	1819

(Assuming 8350 B. T. U. per lb. dry bagasse and 80°F. Room Temp.)

Since 75 to 100 per cent. excess air is not considered abnormal, it is evident that there is not much danger of overheating the furnace. It is also usually found that the actual furnace temperature is less than the computed, especially where heat is removed by radiation.

Mr. KERR[1] took many furnace temperature readings and submitted the following in his general remarks :

Factory.	Average Furnace Temperature.	Average Rate of Combustion.	Average Evap. per lb. Dry Bagasse.
A	1633	130	4·64
B	1511	90	4·10
C	1420	62	4·00

(Factory "A" had highest CO_2 readings.)

These figures are lower than the figures from the above table under 50 per cent. moisture, the approximate moisture content of Cuba and Louisiana. Why there should be so much discrepancy is not known, unless heat is allowed to escape by radiation. One very important point is indicated, though, and that is the benefits of the higher temperatures.

Under a closed furnace and one that is known to be quite hot, there are conditions present that appear as if the firebrick was melted on the furnace surface. I am inclined to believe that this is a chemical action due to the iron and lime in the bagasse and not a temperature action. Calcium and iron are both violent fluxes to fireclay brick made of normal mixtures of oxides of aluminium and silicon. An analysis of furnace ash selected at random by the H.S.P.A. Experiment Station showed 6·43 per cent. iron and 6·23 per cent. lime.

G. F. GEBHARDT states that the temperatures necessary to cause a union of oxygen and fuel are approximately as follows :

Carbon Monoxide—1211°F. Hydrogen—1100°F.

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[1] "Tests of Boilers with Bagasse," page 70.

It is very important that the temperature of gases should not be lowered below the point of combustion of carbon monoxide until we are assured that this combustible has been consumed.

This leads us to the consideration of complete combustion. The large lumber companies of the Northwest, realizing the value of waste wood and hog fuel in saleable electrical energy, have done extensive research work in furnace development.

Mr. KERR[1] was not able to draw any conclusive deduction about furnace volumes in his report on account of other variations. The only dangers then of too large a furnace are radiation and leakage losses. There is an economical limit to the amount of excess air that should be admitted for combustion. Adding more air will so increase the volume of gases as to incur losses at the expense of complete combustion.

Practically every furnace of fairly large dimensions, designed for bagasse or wood waste fuel, has ports of auxiliary air inlets for the admission of air other than through the fuel bed. JACOBUS[2] and SIMERAL[3] claim "that gases containing excess air will ordinarily mingle more readily with the hotter gases containing unconsumed combustible matter, if they are made to travel over and above the hotter gases within the furnace, as this leads to an eddying action, due to the greater density of the gases containing excess air."

It is interesting to note that this theory has not been put into practice, the engineers probably depending on the shape of the furnace to accomplish the mixing action. For the nearest approach to the ideal furnace, then, the main consideration is the shape of the furnace. It is not sufficient to be large enough. It is more important to have it long enough. This is necessary to allow time for mixing and time for complete combustion after mixing has taken place. The more complete the mixing, the more thorough the combustion, and the less excess air will be required for complete combustion.

The drop nose arch as shown in both wood-burning furnaces is gaining much favour in assisting in the mixing. I should like to see this principle tried out. If applied, this feature would have these advantages: (1) Protect the furnace from radiating heat to boiler and reflect high furnace temperature on fuel bed, producing quick evolution of volatile matter. (2) In conjunction with a bridge wall, would impose a barrier to smooth flow of gases, the bridge wall below and the drop nose above, creating an eddying and mixing action aiding in complete combustion with minimum excess air. (3) The bridge wall and drop nose create an actual longer path for gas travel allowing time for complete combustion. (4) The deflecting of the gases down, insuring that a section will act as part of the combustion space.

It is not claimed that this is the only way to accomplish these results. There is room for improvement, and some thought along these lines will bring results.

Dr. CHARLES F. BAKER, Dean of the College of Agriculture, University of the Philippines, in a speech advocating the provision of adequate research stations,[4] said:— "To-day all of the most successful sugar producing countries are very active in research work and support such work very adequately and very generously. Large staffs of highly trained and long experienced men are employed in Java, in Hawaii and in Cuba. The Philippines alone, of the greater sugar producing countries, is the only one which has not yet built up strong research and investigation in the various technical lines underlying cane culture and sugar production."

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[1] *Loc. cit.* [2] A. S. M. E., *Transactions*, 43, 8, 83. [3] *A. S. M. E. Journal*, 1925, 550.

[4] *Proceedings of the Third Annual Convention of the Philippine Sugar Association, 1925*, page 6.

Recent Work in Sugar Cane Agriculture.

VARIETIES OF SUGAR CANE IN QUEENSLAND. *H. T. Easterby. Bureau of Sugar Experiment Stations. General Series, Bulletin No. 2, Second Edition (revised 1896).*

This important summary is divided into a number of sections. After a few introductory remarks, a full list comprising all the cane varieties, known to the author as having been introduced into Queensland, occupies eleven closely printed pages. As there are 60 lines to the page, we have here the records of between 600 and 700 cane varieties, which have been more or less carefully tested as to their suitability for growth in the Queensland sugar zone. It goes without saying that only a few of these have reached the fields as commercial canes; the Sugar Bureau is of comparatively recent origin and has itself distributed only some 50 of those mentioned for large scale cultivation. The full list is comprehensive enough; commencing with some 40 cane varieties known to have been introduced before 1874, it details a succession of immigrants from that date until 1925; we thus have outlined the history of the sugar industry, from this point of view, for over half a century. Practically every sugar cane country has been laid under contribution. We note some dozen and a half of Barbados seedlings and between 30 and 40 from Demerara, but only one of each has apparently survived, to be recommended for cultivation at the present time. But of far more importance and interest are the New Guinea canes. There appear to have been three separate introductions of these. In 1896 TRYON collected some 70 hitherto unknown varieties from the wilds of this great island; a further list is given of canes obtained by WELLS in 1912, which brought up the total to 185; and, lastly, a still larger collection, made by the Colonial Sugar Refining Company, was added in 1914, under numerals 14 NG 123 to 255 — totalling about 320 cane varieties from New Guinea alone, or practically half of the complete list.

In this first list, locally raised seedlings are not included, and the next section deals with these. The seedling work was at first carried on in the southern part of the zone, 17 seedlings being obtained from 700 arrows in 1889, by the Queensland Acclimatization Society; and work was continued in this part for several years, with varying but more or less unsatisfactory results. The letter Q refers to such seedlings as were raised in this period. In 1901 the Colonial Sugar Refining Company started seedling work in the north, where the canes arrowed much more freely; but after only four years they transferred their seedling work to Fiji; the letters HQ indicate seedlings raised by them in Queensland. Lastly, in 1921, the Sugar Bureau commenced work at the South Johnstone Station after being instructed in the methods by the officers of the Colonial Sugar Refining Company; such seedlings as have thus far being raised are indicated by the initials SJQ, but none have yet reached the stage when they can be recommended for cultivation. A certain number of Q and HQ seedlings are giving excellent results; and it seems to be a great pity that this important work was allowed to suffer from so long a hiatus. A few seedlings were found some years ago growing on the sandy bank of the Murray river, and are initialled MQ, but none of these appear in the select list referred to below.

A third section deals with a close study of the characters of cane varieties, which have been grown in the fields at any time in Queensland. Separate paragraphs are devoted to some 118 of these, although the descriptions vary a good deal as to the amount of information contained. As examples, the paragraphs on NG 15 and NG 24 are here repeated.

NG 15. (New Guinea name "Badila"). A dark purple to black coloured cane. Stout sticks, with pronounced waxy rings at the nodes; internodes usually 2 to 3 in. long

but sometimes longer, especially in ratoon canes; habit erect; foliage also somewhat erect and very green; eyes generally full and prominent; trashes easily. Sparse arrower. The foliage of very young cane has a slightly reddish tinge. Flesh white and highly saccharine. A remarkably heavy cane weighing 1 lb. per foot. Greatly appreciated by labourers as it is so easily cut, trashed and loaded. C.c.s.[1] 15·5 to 17·5.

NG 24. (New Guinea name "Goru" or "Goru possi possana"). A greenish brown to copper coloured cane, moderately stout. Joints have a pronounced zigzag appearance; internodes usually 3 to 4 in. long. This cane has a slight waxy bloom. Habit: Inclined to lodge. Basal end develops roots, and upper eyes sometimes shoot. Foliage broad and plentiful, trashes readily, flesh yellow. Arrows. C.c.s. 13 to 15.

A further section deals with analyses of cane varieties at present grown commercially in Queensland (plants and ratoons), under the headings age, Brix, sucrose in the juice, purity, fibre, C.c.s., and arrowing data.

Lastly, recommendations are given as to the varieties considered most suitable for the various tracts, proceeding from the north to the south of the sugar zone; there are 11 such tracts mentioned, with six in the north, one in the centre, and four in the south. It will be remembered that, in the north, there is abundant rainfall and high temperature, and that these factors steadily diminish as we proceed southwards, till droughts and frosts appear almost to be the rule. These recommendations should be extremely useful to the cane farmers, as they are based upon experience gained, both in the laboratory and on the many farms annually visited by the staff of inspectors. The list is of course chiefly of local interest; but, with such wide variations in climatic factors in the 2000 mile stretch on the east Australian coast, the list of successful varieties will be of more general interest as well. Extracting a few notes from this section, it may be noted that NG 15 (Badila), D 1135, and Q 813, 970 and 1121 are recommended for every section: HQ 426 for all except the Herbert river in the north: EK 28 for all save the extreme southern tract: B 147 for most places in the north: HQ 285 and Q 855 for all except the extreme north: Badila seedling for all except the tracts 8-10 in the south: NG 24 (Goru), 7 R 428 (seedling from Rarawai in Fiji), and Hybrid No. 1 for the northern and middle section only. EK 1 only appears in the list for Moreton district in the south. Summarizing, besides those canes suited to all conditions, the canes recommended for the north include B 147, Q 903, Badila seedling, NG 247, R 428, and Hybrid No. 1; those for the south include NG 16, HQ 285, and Q 855. The lists are given in paragraphs, and would be much easier to deal with if placed in some tabular form.

NOTES ON QUEENSLAND CANE INSECTS AND THEIR CONTROL. *Edmund Jarvis*· *Ibid. Division of Entomology, Bulletin No. 19, 1926.*

This bulletin consists of a reprint of the "Monthly Notes" scattered through the pages of the local *Agricultural Journal* and other periodicals, and regularly distributed in typed form. The present publication, being supplementary to Bulletins 17 and 18, covers the period from October, 1923, to December, 1924· Most of the data refer to the Cairns district in the extreme north where the climate is tropical. The various papers are collected and, as usual, printed in date order, but the matter is rendered more accessible by the addition of a copious subject index. The *Bulletin* is also illustrated by a dozen plates and a certain number of figures in the text. Several of these are of great interest, and represent a considerable amount of research work. The two photographs of show cases (cane pests in Queensland and their enemies) would be of much more interest and value if the descriptions were more legible.

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[1] The local determination of "Commercial Cane Sugar" adopted by the Queensland Cane Prices Board.

NOTES ON THE ECONOMIC STATUS OF CERTAIN CUBAN HOMOPTERA. *Herbert Osborn. Tropical Plant Research Foundation. Scientific Contributions, No. 1. (Reprinted from "The Journal of Economic Entomology," Vol. 19, No. 1, 1926.)*

About 20 species of insects of the leaf hopper type are discussed in these notes, attention being specially directed to those which have been noted as readily migrating from sugar cane to grasses and the reverse; the specimens were collected by the author during a recent visit. Under each insect's name is given a list of food plants, and suggestive remarks are added as to the possibility of its transmitting such a disease as mosaic from grasses of cultivation to the canes. The only forms met with on the sugar cane, in such quantities as to suggest that this was their principal food plant, were *Stenocranus saccharivora*, the West Indian cane leaf hopper, and the cane arrow leaf hopper. But it is well known that mosaic is transferred by forms which feed on grasses by preference and only visit the cane, as it were, by accident, and thus transfer the disease to it; hence the importance of as full a knowledge as possible of the habits of this type of insect, whether feeding habitually on the cane or not. Although the number of species of Homoptera present in Cuba does not appear to be very great, in comparison with Central and South America, there are many forms which multiply to such an enormous extent that they must be considered destructive pests of the grass crops. Grasses indeed may be regarded as the most heavily and universally infested of any plants by leaf hoppers; and Cuba appears to be no exception to this rule. The complete list of species collected, with the detailed notes, will be published in another article.

DETERIORATION OF SUGAR CANE DURING ITS STORAGE BY WINDROWING. *Phani Bhusan Sanyal. Memoirs of the Department of Agriculture in India. Chemical Series, Vol. VIII, No. 7, December, 1925.*

Windrowing of the sugar cane has been an established practice for many centuries in India, especially in the north, where a considerable time elapses between the correct harvesting period and the time of planting; and certain of the methods used have been described briefly in a former number of this Journal.[1] But the chance of establishing a cane + beet factory at Peshawar widened the study, and a series of analyses were made there of cane buried in the ground for various periods. The whole study was later transferred to the other extreme of the Indo-Gangetic plain, and laboratory and field observations were made on the Pusa farm. These studies were referred to in this Journal during 1920 and 1921[2]: the present bulletin gives interesting details of the work carried on at Pusa during 1920 to 1923, and up to the present time.

The Bulletin is divided into two parts as follows:—(1) Factors responsible for the deterioration of sugar cane windrowed in the field. Possibility of its successful storage in Bihar: and (2) Mechanism through which the inverting enzyme in windrowed sugar cane is brought into activity on rainfall and causes its deterioration. We shall consider the first part in some detail and merely give the summary of conclusions at the end of the second part.

The results of experiments in Peshawar during 1917-18 and 1918-19 clearly showed that cane can be safeguarded for a certain period by windrowing, after which rapid deterioration sets in. The factors concerned were supposed to be biological or seasonal. The periods during which the cane remained good varied considerably in the different experiments, and in 1918-19 deterioration set in at the same time, whether the canes were buried early or late in the cold weather.

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[1] *I.S.J.*, 1920, pp. 368-369. [2] *Ibid*, 1920, pp. 369-370, and 1921, p. 451.

This suggested that the determining factor was seasonal, and it was significant that the canes remained in good condition as long as there was no rainfall, but deterioration set in rapidly in both cases immediately after a heavy shower of rain. Based on this observation, the experiments were transferred to the headquarters of the Agricultural Chemist at Pusa in Bihar and, as will be seen, a method was evolved for the successful storing of canes in that country. This may prove to be a matter of some importance in helping to lengthen the milling season.

As practised in Peshawar and at Pusa, the operation of windrowing consisted in cutting the canes 3-4 in. below the ground surface, and laying the cut canes over one another so that the leafy tops of each layer covered the canes of the one below : the object was to cover completely the actual canes with a thick layer of trash, so as to prevent drying out ; while the addition at the base of two or three joints with hard rinds rendered it difficult for fungi or bacteria to enter the canes after being cut. Experience has shown that, if the canes are cut at all high up, rapid drying and deterioration take place.

An account is given of the experimental work done at Pusa during the years 1920-23, with tables of analysis, as in all parts of the bulletin. In 1920–21 two lots of Sathi 131 (a thick cane which has been thought to be the same as Mauritius 131), windrowed in December and February, were tested by analysis at intervals. There was no rain of consequence during this period, and the minimum and maximum temperatures were 19°C. and 27°C. respectively. The result of the December experiment was that the canes remained in quite good condition for 51 days : the total solids in the juice increased, while a decrease in weight of canes showed that a certain amount of drying had taken place : there was an increase in sucrose content and purity and no appreciable increase in glucose, as shown by the analyses. The result of the February experiment was of a very different nature. There was a tendency towards deterioration from the commencement and, after 18 days, this became distinct although there was still no rainfall. The maximum temperature had meantime risen to 32°C., suggesting that this might be the factor concerned. Later on, the deterioration increased and became rapid as the maximum temperature slowly climbed to 41·4°C. The general results thus show that while it is possible to preserve cane by windrowing in the field at Pusa during the months of December to January, this is not so during February to March when the temperature becomes high.

In 1921–22 similar experiments were made with an Indian thin cane (Maneria, of the same class as Uba), but on December 23rd and January 23rd there were appreciable falls of rain which wetted the canes, and immediate deterioration set in in consequence. In 1922–3 an experiment was made of guarding the windrowed canes from both rainfall and insolation and the resulting rise in temperature. On January 9th and on February 1st plots of about one thirtieth of an acre were lifted and divided into two halves, one of which was windrowed in the field and the other under cover, and thus protected from rain and sun. The cane this time was Co 213. A comparison showed that, while the protected canes remained in excellent condition for over one month, rapid deterioration took place in the canes buried in the field. Thus the possibility of windrowing canes in Bihar was demonstrated, provided that the canes were placed in the shade.

Laboratory experiments were next instituted with pieces of cane exposed to various temperatures : each piece consisted of one internode with two nodes, the ends being sealed with a protecting layer of paraffin. The composition of these pieces was determined after cutting and again after a period of three days. The temperatures employed were 20–24°C, 27-31°C, and 47–51°C. The analyses showed that the canes remained good at 20–24°C, while deterioration was quite pronounced at 27-31°C and, the higher the temperature above 24°C, the greater the loss in weight and the more rapid the deterioration. This experiment was then repeated with temperatures of 20, 25, 30, and 40°C, the pieces being exposed to these temperatures for six days. The analyses showed conclusively that cane, when exposed to 25°C, begins to deteriorate rapidly: hence, when the maximum temperature reaches this level windrowing cannot be successfully undertaken. It should be noted that this factor of temperature does not come in with regard to the cooler climate of Peshawar, for the average maximum temperature there for 33 years does not reach 24°C till the end of March.

The second part of the paper contains various observations and experiments on the enzymes present in the cane. Perhaps the most interesting result, which might well have been included in the first part, is the clear demonstration that evaporation from cut pieces of cane takes place entirely in the nodal region, where the root eyes and bud have their place: the hard covering of the internode appear to be a perfect protection from any loss of water by the cane. The general summary of results is as follows:—

(1) The deterioration of sugar cane stored by windrowing is effected by the enzymes in it.

(2) Enzyme activity can be efficiently checked and the cane preserved in good condition if it is well covered in a dry place so as to avoid rapid evaporation of moisture from the cane.

(3) On rainfall, water enters the uninjured windrowed canes through the nodes, where the invertase is much more abundant that in the internodes.

(4) On the passage of water through the nodes the inverting enzymes are translocated into the internodes and cause the deterioration of the canes.

(5) Moisture induces germination in sugar cane. Much of the reducing sugar, that disappears when the windrowed canes undergo deterioration on wetting, goes to form new tissue (roots) in the germinating plants.

(6) Spontaneous deterioration of windrowed cane is due to rapid evaporation of moisture which possibly helps the diffusion of invertase from nodes to internodes of cane.

C. A. B.

Publications Received.

Chemical Engineering and Chemical Catalogue. Edited by D. M. Newitts, Ph.D., B.Sc., A.I.C. Second Edition. (Leonard Hill, London). 1926.

This catalogue of chemical products and chemical plant is now enlarged somewhat,[1] but it can hardly yet claim to give a complete index of companies catering for the various branches of chemical industry. Under the heading of "Sugar," for example, against mills no firm making cane milling or beet juice extraction machinery is represented, the plant there listed consisting mainly of less important accessories. But the general arrangement of the book is on practical lines, and the various commodities listed are quite fully indexed. Perhaps the most interesting feature is an article by Sir Robert Hadfield on "Corrosion," to which the reader naturally at once turns. Sir Robert tells us that he has had the opportunity of examining a small piece of the famous wrought-iron Pillar of Delhi, which through 17 centuries has entirely defied the ravages of corrosion, whereas products of ordinary iron and steel have suffered considerably from these ravages. But he is not able to state definitely the secret, beyond showing that the metal is remarkably free from slag and other inclusions, and consists of large grains of ferrite with a very small portion of cementite, though from the metallographic point of view there is nothing very remarkable about that. Probably the very dry nature of the air in that part may have something to do with the remarkable state of preservation of the Pillar, but this explanation is considered unsatisfactory. It is believed to be explained by the *nature* rather than by the composition of the metal, though at present apparently metallurgical science can state nothing more precise than this.

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[1] *I.S.J.*, 1925, 217.

The Preparation of Levulose. By Richard F. Jackson, C. G. Silsbee, and Max J. Proffitt. Scientific Papers of the Bureau of Standards, No. 519; Department of Commerce, Washington. (Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.). 1926. Price: 10 cents.

This Scientific Paper deals with the preliminary experiments performed on the laboratory scale at the Bureau of Standards with the purpose of examining the practicability of manufacturing levulose commercially. It describes the nature of the sugars present in raw material (artichokes and dahlias), their extraction, conversion to levulose, precipitation of this sugar as levulose, and crystallization procedure. It is shown that pure white levulose is capable of forming massecuites which can be purged centrifugally with a facility approaching that of sucrose.

Meine Antwort auf die "Erwiderungen" des Vereins für Chemische und Metallurgische Produktion in Karlsbad. Dip. Ing. K. Zert. Tagesfragen aus der Zuckerindustrie. (Albert Rathke, Magdeburg). 1926. Price: 1 mark (unbound).

This is a continuation of the controversy on the relative merits of "Carboraffin" and "Norit" as purifying agents for use in the manufacture of white sugar in the beet factory.[1] It is a matter which is arousing some attention and those of our readers who are interested are referred to the considerations here set forth at some length.

(*A*) **A Trichromatic Colorimeter Suitable for Standardization Work.** *B*) **A Criticism of the Monochromatic Plus White Method of Colorimetry.** (*C*) **On a new Method of Colorimetry.**[2] Reprints from the *Transactions of the Optical Society*, 1925-26, **27**, No. 2, 106-129, 130-138, 139-158.

Die Pektinstoffe. Rudolph Sucharipa. (Verlag, Dr. Serger and Hempel, Braunschweig, Germany). 1926. Price: M. 6.

This is a review of our present knowledge of pectin substances from the points of view of their constitution, their manufacture, use in the production of jams and jellies and marmalades, and determination and detection. It is compiled with considerable thoroughness, and gives a very complete bibliography and patent list. Chemists interested in pectin products will find this monograph a welcome appreciated addition to the literature of the subject, which, anyway, is rather sparse.

Trade Notice.

Those of our readers who would like the recently issued Sugar Pamphlets of the Mirrlees Watson Co., Ltd. in Spanish are informed that these can now be obtained in that language on application to the Company at Scotland Street, Glasgow. They relate to Mill Rollers, Meinecke Chutes, Multiple Effect Evaporators, Searby Cane Shredders, Peck Juice Strainers, and Revolving Cane Knives.

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[1] See *I.S.J.*, 1925, 66; 1926, 214, for previous contributions to this debate.

[2] See also *I.S.J.*, 1926, 331.

Review of Current Technical Literature.[1]

INVERSION AND THE H.I.C. OF CANE JUICE. *H. A. Cook. Reports of the Association of Hawaiian Sugar Technologists, October, 1925.*

There is still some conflict in opinion among investigators as to the actual mechanism of the inversion process, though on one point there seems to be complete agreement, and that is, that this mechanism is a function of the hydrogen ion. But it is difficult to determine to what extent the theoretical considerations derived from a study of pure sucrose solutions can be applied to a complex composition such as mixed juice or clarified juice. In the former case the number of variables can be reduced to a minimum, which cannot be done in the latter. Data published by McAllep and Bomonti[2] indicated that there is a quite definite reaction in terms of hydrogen ion concentration below which inversion, in detectable quantities, takes place in cane juices when held at high temperatures. This reaction was found to be considerably more alkaline than has been generally supposed to be the case. Unpublished data on the study of the rates of reaction changes in clarified juices at high temperatures show that there is a marked similarity in the reaction curves for different juices, although there may be quite a difference in the reaction rate in different juices. These results show that juices become acid at much faster rates than is generally supposed. Little data is available to give any clue to the cause of this rapid development or increase in the hydrogen ion activity, although there is a wide difference in opinion. Whether it is due to decomposition of "glucose" in alkaline solutions or to the decomposition of other substances, it seems apparent that there is development of an acid, since there is a marked increase in the activity of the hydrogen ion, this activity increasing with increase in temperature. All of these results show that there is need of just as close control of the reaction of the clarified juices as there is of the reaction of the juices at the liming station.

Another factor that at present makes imperative the reaction of ths clarified juice as a basis of control is the apparent difference in the resulting reaction of different juices when limed to apparently the same reaction and subjected to the same conditions of temperature. It has been noted that there is a decided difference in the amount of drop in *pH* secured in different juices between the cold limed juice and the hot limed juice leaving the heaters. In some cases the drop in *pH* between the cold limed juice and the clarified juice is only from 0·2 to 0·3 *pH*, while in other cases a difference amounting to as much as 0·8 or 0·9 *pH* has been noted. Whether this difference is due to: (1), slight differences in the initial *pH* of the cold juice; (2), to differences in the temperatures in the heaters; or (3), to inherent differences in the juice, has not yet been definitely determined. Anyway, it is certain that it is almost imperative that the reaction of the clarified juice be carefully controlled in order that inversion through the process be avoided. The mention of inversion losses is often scoffed at, but it is now a recognized fact that inversion takes place in delectable amounts at much more alkaline reactions than has been generally supposed. If the resulting loss, which would accrue to a factory by the inversion of 0·1 per. cent. of sucrose in clarified juice, were calculated, the result would be surprising to many factory operators. There will undoubtedly be developed, in the very near future, some means for the automatic control of the reaction of the juices in the sugar-house on a hydrogen ion concentration basis, as has already been developed in many industrial processes. Using the colorimetric method, with reaction plates, and with standard colour charts, a simple method of control has been evolved, making it possible to place the results of different factories on a comparable basis, in terms comprehensible to all. These results show that the liming practice of some factories is very regular, and in others the very reverse, and many have greatly reduced the undetermined losses by careful attention to the reaction of the juices going through the house. Further, in one house a gain of 0·3° purity in the clarified juices is credited to this H.I.C. control, which gain would more than pay all expenses of the investigational work at the Experiment Station in making the charts and the cost of their production.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *I.S.J.*, 1925, 382-385.

Review of Current Technical Literature.

Temperature Correction Table for the Baumé Hydrometer. *Anon.* *Circular of the Bureau of Standards, No. 295 (received, May 1926*[1]*).*

A temperature correction table for the Brix hydrometer exists, but none is available for the Baumé scale, so that when Baumé readings are made at temperatures other than the standard it has been necessary to convert to the equivalent degree on the Brix scale, correct for the difference of temperature and and re-convert to the Baumé reading. But the following table now eliminates this tedious calculation. It is based on the values of the thermal expansion of sucrose solutions of Plato and is supplementary to the Baumé table of Bates and Bearce,[2] which at 20°C. has the modulus of 145, lying therefore about midway between the "old" or "Holland" table (modulus 144), and the "new" or "Gerlach" (modulus 146·78).

Temp. degrees Centigrade.	Observed degrees Baumé								
	0	5	10	15	20	25	30	35	40
	Subtract from observed degrees Baumé :—								
0	0.17	0.34	0.47	0.57	0.65	0.72	0.77	0.79	0.81
5	0.21	0.30	0.39	0.45	0.51	0.55	0.59	0.60	0.61
10	0.18	0 23	0.28	0.32	0.36	0.38	0.40	0.41	0.42
11	0.18	0.22	0.26	0.29	0.32	0.34	0.36	0.37	0.38
12	0.17	0.20	0 23	0 26	0.29	0.31	0.32	0.33	0.34
13	0.15	0.18	0.20	0.23	0.25	0.27	0.28	0.29	0.29
14	0.14	0.16	0.18	0.20	0.22	0.23	0.24	0.25	0.25
15	0.11	0.13	0.15	0.17	0.18	0.20	0.20	0.21	0.21
16	0.10	0.11	0.13	0.14	0.15	0.15	0.16	0.17	0.17
17	0.07	0.08	0.10	0.11	0.11	0.11	0.13	0.13	0.13
18	0.05	0.06	0.07	0.07	0.08	0.08	0.08	0.08	0.09
19	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05
	Add to observed degrees Baumé :—								
21	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05
22	0.06	0.06	0.07	0.07	0.08	0.08	0.08	0.09	0.09
23	0.09	0.09	0.10	0.11	0.12	0.13	0.13	0.13	0.13
24	0.12	0 13	0.14	0.15	0.16	0.17	0.17	0.17	0.17
25	0.15	0.17	0.18	0.19	0.20	0.21	0.21	0.21	0.21
26	0.19	0.20	0.22	0.22	0.24	0.26	0.26	0.26	0.26
27	0.23	0.23	0.25	0.27	0.29	0.30	0.30	0.30	0.30
28	0.26	0.27	0.29	0.31	0.33	0.34	0.35	0.35	0.34
29	0.31	0.31	0.34	0.35	0.37	0 38	0.39	0.39	0.38
30	0.35	0.35	0.38	0.39	0.42	0.43	0.44	0.43	0.43
35	0.56	0.57	0.60	0.63	0.65	0.66	0.66	0.66	0.65
40	0.81	0.82	0.85	0.87	0.89	0.90	0.90	0.89	0.88
45	1.09	1.09	1.12	1.14	1.15	1.15	1.14	1.13	1.11
50	1.40	1.39	1.42	1.42	1.43	1.41	1.40	1.37	1.33
55	1.74	1.72	1.73	1.73	1.71	1.69	1.66	1.62	1.57
60	2.10	2.08	2.06	2.05	2.00	1.97	1.92	1.87	1.82
65	2.50	2.50	2.40	2.40	2.30	2.20	2.20	2.10	2.10
70	2.90	2.80	2.80	2.80	2.60	2.60	2.50	2.40	2.30
75	3.50	3.30	3.20	3.20	3.10	3.00	2.90	2.70	2.60
80	4.00	3.90	3.80	3.70	3.50	3.40	3.30	3.10	2.80

Tests made in South Africa with a "Turbine" Furnace for Bagasse. *Anon.* *South African Sugar Journal, 1926, 10, No. 3, 149-151.*

For the tests a "Turbine" forced draught steam jet furnace, together with a special design of vertical coking arch, was fitted on a water-tube boiler having a heating surface of 2200 sq. ft. rated at 6700 lbs. of water per hour on good coal, replacing the ordinary step-grate bars hitherto employed. Unfortunately there were no means of accurately weighing the amount of bagasse used on the tests, but the following are typical of the other figures obtained before and after the furnace was fitted:—

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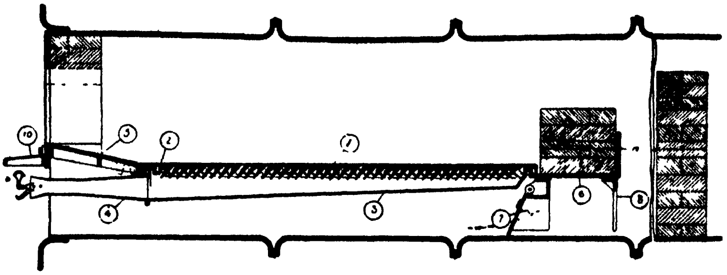
[1] Obtainable from the Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A. Price: 5 cents.

[2] Bureau of Standards, Technical Paper No. 115.

	Ordinary Step Grate Furnace		"Turbine" Forced Draught Furnace and Special Coking Arch.
Duration of test (hours)	5·0	.	7·0
Average boiler pressure (lbs. per sq. in.)	87	....	95½
Temperature of feed water	140°F.	....	140°F.
Temperature of flue gases	410°F.	....	580°F.
CO_2 in flue gases	9·5%	....	13·4%
Water evaporated in the boiler per hour	4625 lbs.	....	6784 lbs.
Water evaporated per sq. ft. of heating surface per hour	2·20 lbs.	....	3·08 lbs.

The very pronounced improvement in efficiency will be obvious by the fact that the boiler was evaporating 47 per cent. more water than before, actually higher than the rated capacity on coal, while full steam pressure was maintained much better, in this particular case, the furnace having been installed to increase the evaporation from the existing boiler plant. Also the CO_2 had increased from 9·5 per cent. to 13·4 per cent. and the temperature of the combustion gases from 410° to 580°F., a clear indication of the increased efficiency of the combustion. The general principle of the arch design used is on the usual lines of a reservoir of heat to aid the combustion of the residual material on the grate, but a regulated amount of secondary air is also used to ensure the complete combustion of the volatile products which as a rule are only partially burnt under ordinary conditions. The furnace is in use all over the world, especially for refuse fuels. Its grate design consists essentially of a number of longitudinal heavy cast-iron trough firebars fixed side by side containing a large number of special small cast-iron firebars or elements which are placed transversely into the troughs and rest on the edges, interlocking into one another, the trough, containing, for a 6 ft. grate about 52 of the latest "slot" pattern. Between each of the small transverse firebars is a row of nine tiny slots for the passage of the air blast, so that the surface of a 6 ft. × 3 ft., for example, consists of about 250 of these elements interlocked together, equivalent to over 2000 of the air slots, communicating with the air steam blast in the trough underneath, which gives an equal distribution of the air blast over the whole grate surface, both longitudinally and transversely, difficult to obtain in any other way. These small transverse firebars are in the form of a "V" section lying inclined so as to dip into the air steam blast in the troughs, the name "Turbine" being derived from the likeness of the arrangement to a steam turbine of the De Laval type, the steam to each of the trough firebars being supplied by means of a steam nozzle, as controlled by a regulating valve. The main advantages of the design are that the heat is localized in the boiler, while the life of the firebars is very many years because of the cooling and protective influence of the steam. The intensity of the draught is under easy control, while the amount of steam used for the nozzles is not more than 3 per cent. of the water evaporated in the boilers, as compared with say 2½ per cent. for mechanical draught. No skilled labour is required for operation.



1, firebars; 2, firebar locking bar; 3, air trough; 4, injector; 5, deadplate; 6, bridgeplate, 7, cleaning door frame; 8, bridge support; 10, ash guard.

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Review of Current Technical Literature.

CLARIFICATION OF CANE JUICE: ITS PHYSICAL AND CHEMICAL NATURE. *Walter E. Smith. Reports of the Association of Hawaiian Sugar Technologists, October, 1925.*

Clarification of cane juice is found to consist of four main physical or chemical reactions: (1) Flocculation of colloids by change of hydrogen-ion concentration; (2) flocculation of those colloids that are coagulated by heat; (3) formation of insoluble lime salts; and (4) formation of soluble lime salts and chemical reaction products. Production of a clear resulting juice is apparently the combined result of flocculation by change of reaction and heat, and the formation of insoluble lime salts. Simple change of reaction together with heating will not of itself result in the clear, sparkling clarified juice which is met in practice, because apparently certain colloids are not precipitated under these conditions. Much of the suspended matter remaining in colloidal dispersion is carried down, however, by occlusion within the flocculent and voluminous precipitate of calcium phosphate produced by the reaction of the lime with the phosphoric acid of the cane juice. Thus the two phases of the reaction supplement one another and combine to produce juice of varying clarity, depending apparently on the over-all efficiency of the two factors in the reaction: the efficiency with which the colloids are coagulated by heat and alkalinity alone, and the production of the calcium phosphate precipitate. This theory of clarification offers a fitting explanation of practical observations: That for a given phosphoric acid content, the clarity of the juice reaches its maximum slightly beyond the neutral point of phenolphthalein in the cold limed juice, thus establishing that as the optimum point when clarity of juice is used as the basis for comparison; that for a given reaction the clarity of the juice increases with increase in phosphoric acid, although not necessarily in this proportion after we reach an amount sufficient to meet the requirements; and last, that juice deficient in phosphoric acid will not yield bright, clear juice even if the reaction is at the maximum permitted by other working considerations. Formation of soluble lime salts and chemical reaction products may be considered as an incidental phase of the question, introducing other factors which may set a limit on the extent to which we may carry liming; of this much has yet to be said. For purposes of continuous operation, general practice favours heating juice practically to the boiling point or slightly beyond. This seems to give the best flocculation and to reduce the volume of settlings to the minimum for the existing conditions. With this factor set approximately at the boiling point, the only remaining factor within our control is that of the reaction at which clarification is conducted, the ideal being that which would give us: (1) Maximum elimination of non-sugars; (2) minimum liability to loss by inversion; (3) most complete flocculation of colloids, and most rapid settling; and (4) greatest clarity of resulting juice. Of these, the first two are of paramount importance, affecting as they do the final recovery; but the third, while actually a limiting factor in many cases, should really be subordinated to the main issues, and may, ordinarily, be adjusted by the installation of sufficient *suitable* equipment properly operated. Clarity of juice is desirable as this becomes one of the major factors in determining the filtering qualities of the sugar produced. Clarification investigations conducted at the Hawaiian Experiment Station have shown that in general the maximum increase in purity between mixed juice and clarified juice is obtained at a reaction of *pH* 8·0-8·3 in the hot limed juice. Further examination of this reaction from the standpoint of the ideal set out above shows it to meet fully the second and fourth requirements. At an original reaction of 8·0-8·3 *pH*, the clarified juice will not fall below 7·5 *pH*, and at this hydrogen-ion concentration inversion will proceed so slowly, even in juices heated to the boiling point, that under practical working conditions losses may well be considered negligible. Further, at this reaction the clarity of the resulting juice reaches a practical maximum. The advantages which accrue when clarification is carried at a reaction of 8·0-8·3 *pH* in the heated juice are so specific under Hawaiian conditions as to warrant proceeding on the basis that this shall be the ideal at which we aim, and any attendant disadvantages must be considered simply as difficulties to be overcome. To maintain clarification at this optimum reaction, meanwhile operating at normal grinding rate and at full efficiency from the conventional standards of boiling house practice, may then be considered "the factory problem of clarification."

RESEARCH WORK AT THE BUREAU OF STANDARDS ON THE ESTABLISHMENT OF DEXTROSE AND LEVULOSE INDUSTRIES. *Frederick Bates.*[1] *Communication from the Bureau of Standards.*

Dextrose.—"Inasmuch as the world had long waited for a carbohydrate of high food value, great purity, low cost, and low sweetening power, the Bureau of Standard's resources were turned to a solution of this problem. An exhaustive study of the crystallization of dextrose from water solution was carried out, and has resulted in the establishment of a new industry, which is already of large proportions. Continuous efforts to solve this problem had been made by the dextrose industry for over 40 years. In 1919 . . . . this Bureau sent one of its associate chemists from the carbohydrate laboratory to the Edgewater, N.J , plant of the Corn Products Refining Company, where he immediately threw down 4000 lbs. of crystalline dextrose, thus demonstrating to that company and to the world that it was perfectly feasible to produce chemically pure dextrose at a low cost on a large manufacturing scale As a result of the Bureau of Standards' discovery, one factory of the Corn Products Refining Company, costing over a million dollars, is now making about 350,000 lbs. of this material per day, and other corn products refining companies, such as Penick & Ford, Ltd., Cedar Rapids, Iowa, and American Maize Sales Corporation, Roby, Indiana, are already in production.[2] For over a year, large as has been the increase in the output of dextrose, the demand has exceeded the supply. Dextrose had been vitally needed as an adjunct to the use of ordinary sugar. Satisfactory production in some large-scale industries could not be made because of the lack of such a product. It was needed as the perfect "filler." It is also needed in the wine industries of Europe, and the Corn Products Refining Company now has a large factory in Germany, and, we are informed, has been requested by the British Government to erect a factory in England. . . . . "

Levulose.—"After the remarkable results on dextrose had been obtained and a new industry created, the Bureau of Standards felt justified in turning its resources to an experimental study of the last of the three sugars mentioned above, namely, levulose. . . . . The Bureau's first publication on this subject was a strictly scientific paper presented before the Ithaca, N.Y. meeting of the American Chemical Society the week of September 8th, 1924,[3] and carried the announcement that the Bureau of Standards had developed a laboratory method for the successful crystallization of levulose from water solution. It is perhaps permissible to state that no development has occurred in many years which has such possibilities for profoundly influencing man's food supply. . . . The great problem, so far as the world's sugar industry is concerned, has always been the utilization of factory equipment for a period longer than three months in the year. The perishable nature of both canes and beets is their most unfortunate attribute. There are indications that the artichoke can be used to materially lengthen the period of factory operation. The artichoke is stored in the ground. Freezing does not seem to hurt the tuber. The demand for levulose for all purposes, including confectionery, would be enormous were it available at any price within reason. . . . . Indications are that levulose can be produced at a cost equal to and perhaps less than ordinary sugar from beets. The process of manufacture is in most respects very much the same as that now used in our domestic beet sugar industry. The additional machinery needed would probably not run over $80,000 per factory." Dr. BATES concludes this statement of the work of the Bureau by saying that investigations are now in progress for the purpose of determining the cost of manufacturing levulose from artichokes by a process similar to that used in the beet sugar factory. Artichokes yielding 12 to 16 per cent. of sugar have been grown, the amount produced per acre being from 10 to 20 tons, that is a yield of sugar per acre from 1·2 to 3·2 tons.[4]

GERMAN BEET MOLASSES OF THE 1924–26 CAMPAIGN. *A. Herzfeld. Vereins-Zeitschrift, 1925, No. 831, 951–966.* A considerable number of data was collected (polarization, sucrose, raffinose, invert sugar, dry substance, ash, reaction, *pH*, nitrogen, surface tension, etc.), and are here tabulated, the object of the investigation being to examine the question as to any notable differences in the product of raw and white factories and of refineries, that of the latter having been stated to be less valuable for yeast manufacture.—NEW METHOD OF COLORIMETRY. *J. Guild*. *Transactions of the Optical Society, 1925-6, 27, 139-158.* A colorimeter[1] is described whose readings are dependent on two colour matches in which the test colour is matched by a mixture in unknown proportions of a standard colour and a monochromatic colour produced spectroscopically, the standard colour being different in the two matches.—SIGNIFICANCE OF MANURING WITH LIME. *Dr. Gehring*. *Die deutsche Zuckerindustrie, 196, 51, No. 8, 193-197.* This is a review of the important work of KAPPENS, HISSINK, and the author on the great importance in agriculture of scientific lime manuring. Lime not only is a plant nutrient, and a means of correcting the development of acidity, but field tests show that the increased porosity caused by its proper addition coincide with greater yields of beets, and other crops. A method of determining the lime requirement depends on ascertaining (1) the lime which undergoes a base exchange when treated with sodium chloride, and (2) the total amount which the soil is capable of adsorbing, which figures give the "degree of saturation," the optimum of which in practice is 70 per cent.—LOSS OF SUCROSE IN CUT CANE. *W. Scott*. *Tropical Agriculture, 1926, 3, No. 2, 34.* Yet further figures are given showing that the loss of sucrose in the field by delaying unduly crushing after cutting cane be much higher than any that may occur in a modern, well-conducted factory. Thus the loss of available sugar for original weight of cane 24, 48, 72, 96 and 144 hours after cutting was 5·77, 7·55, 14·16, 16·87, 26·62 per cent. in the case of cane supplied to the Usine Ste. Madeleine from Harmony Hall Estate.—DETERMINATION OF LIGNIN IN STRAW, BAGASSE, ETC. *S. Venkateswaran*. *Journal of the Indian Chemical Society, 1925, 2, 253-260.* Method: 1 grm. of ether-extracted straw is hydrolysed for 20 hours at room temperature with 15 c.c. of 72 per cent. sulphuric acid; then the solution diluted to 3 per cent., and boiled under a reflux for 1 hour. At the end of this time the lignin is filtered off, washed, dried at 105° C., weighed and ignited.—VOLUMETRIC DETERMINATION OF PECTIN. *C. F. Ahmann and H. D. Hooker*. *Industrial and Engineering Chemistry, 1926, 18, No. 4, 412-414.* Solutions of pectin are saponified with alkali at 55° C. during 12 hours, and back-titrated with hydrochloric acid. A procedure elaborated on this principle was found with that of the Carré-Haynes method[2] to give reliable results when working with pure pectin. But with plant material the latter method gave less accurate results, owing to the presence of occluded salts in the calcium pectage gel, besides being slower.—COMBATING RATS. *Drs. A. C. and A. L. Hagedoorn*. *Archief, 1926, 34, No. 11, 302-307.* Points made are: That, while a high percentage success was obtained with a para-typhus virus with sewer rats, yet the black house rat remained immune; that para-typhus cultures prepared by transmission through various animals (hens, calves, pigs, dogs, etc.) so as to be virulent to rats, may later become extraordinarily active towards the animals named; that to spread about such cultures is reckless from the point of view of safety to the human population; that the killing of a number of rats has little effect on the situation, as their place is very soon taken by these rapidly breeding animals; and that the problem is to be attacked by trying to make conditions impossible so far as feasible for the living of rats in any place, a method that has met with some success in Java by the medical mission.—ANALYSIS OF CAUSTIC LIME. *J. C. Bailar*. *Industrial and Engineering Chemistry, 1926, 18, 389-390.* In the Great Western Sugar Co.'s laboratory, Denver, Colo., two methods believed to require less time than the usual sucrate procedure are used, the first being to add an excess of standard iodine solution to a solution of 1 grm. of the sample in 500 c.c. of water, and titrate the excess with standard thiosulphate solution. In the second, which is preferred, 1 grm. of the sample in 500 c.c. of water is titrated with a solution of zinc chloride, previously standardized against a solution of sodium hydroxide of such a concentration that 1 c.c. = 1 c.c. of the zinc solution, a mixture of phenolphthalein alazarin cyanin green being used as indicator.

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[1] Chief, Sugar Section, Bureau of Standards. [2] See also *I.S.J.*, 1925, 54. [3] *I.S.J.*, 1924, 599.
[4] For other articles on this subject see: *I.S.J*, 1925, 110, 448. Also "The Preparation of Levulose," by RICHARD F. JACKSON and others; *Scientific Papers* of the Bureau of Standards No. 519 (Government Printing Office, Washington, 10 cents).

J. P. O.

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[1] Constructed by ADAM HILGER, LTD., London, *I.S.J.*, 1926, 325.

[2] *I.S.J.*, 1923, 631; 1924, 480.

Review of Recent Patents.[1]

UNITED KINGDOM.

Clarification of Juice, Syrup, etc. by Chlorination, using also Activated Carbon[2] *Shuichiro Ochi*, of Toyotama-gun, Tokyo, Japan. *249,191.* December 15th, 1924.

In general the process is to introduce active chlorine into the juice to be treated, keeping a temperature of not more than 55°C. meanwhile, and thus bleaching the juice, while retaining it in an acid or neutral state. Secondly, activated charcoal is added in order to remove active chlorine and thirdly or lastly, an alkaline material is added to the juice to neutralize it. Juice thus refined may be thereafter treated in the manner usually employed. It would be expected that the infusion of chlorine into the juice would stimulate inversion (as hydrochloric acid develops, as well as active chlorine), and that heating a solution that has become acid would convert all the sucrose in the solution into invert sugar. But the inventor's practical experience has demonstrated that such inverting effect is almost nil, provided the quantity of active chlorine used is so small as to just complete the bleaching with the temperature kept constantly below 55°C. It is to be noted that the bleaching is perfectly accomplished using the above degree of heat, any higher heat being found neither to improve nor to accelerate the bleaching. Following the bleaching treatment, it is necessary to remove the excess of chlorine which remains after the bleaching operation. This method of active chlorine removal is attained by the aid of the catalytic action of activated charcoal. The next operation is to neutralize the solution by mixing an alkaline agent in the same. This must be done immediately after the above chlorine treatment, using oxides, or carbonates of alkali or alkaline earth metals, or ammonia. Such neutralizing agents may be added to the juice or solution after the infusion of chlorine. *Example 1*:—Into a solution consisting of 100 kg. of raw sugar (15 D.S.) dissolved in 70 kg. of warm water, into which 75 litres (approximately 0·2 kg. in weight) of chlorine gas are blown while constantly stirring a temperature of 20°C. This will be quickly bleached, the brown colour being entirely removed with only a slight yellow tint remaining. Following the above treatment, a mixture of 1 kg. of activated charcoal will remove the free chlorine, and on being neutralized with a strong solution of caustic soda the solution becomes colourless. This solution is evaporated in a vacuum, by the ordinary method. *Example 2*:—Passing a direct electric current between electrodes of platinum or graphite through 100 litres of liquid raw sugar or juice whether in the original condition or in a concentrated form with 0·03 kg. of sodium chloride added, will generate chlorine by electrolysis and the bleaching is hereby effected. To the material thus bleached, 0·05 to 0·1 kg. of activated charcoal is added and after the solution has been neutralized, manufacture is carried out by the usual methods. The juice should be kept at a temperature not exceeding 55°C. whilst the electric current is passed through.

Clarification of Juices, etc., with Hydrogen-ion Concentration Control.* *Gilchrist & Company*, of Chicago, U.S.A. (Assignees of *W. C. Graham*). *247,542.* January 25th, 1926; convention date, February 13th, 1925.

Colloidal impurities are removed from liquids (such as beet, cane, or other sugar juices, &c.), by causing rapid circulation in a body of the liquid and adding a neutralizing reagent, e.g., an alkaline reagent, so as to cause a progressive change in the hydrogen-ion concentration. In treating sugar juice, this is first brought to a temperature of 160-240°F., but preferably 200-212° F., by feeding it through a pipe *6* into a pre-heater *5*, where it

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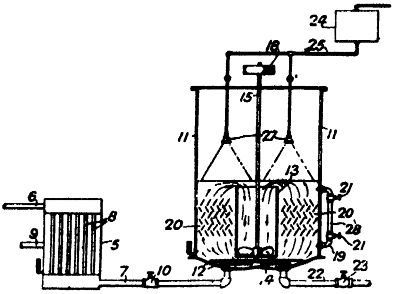
[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. 2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin, Germany.

[2] See also *I.S.J.*, 1926, 273.



passes through tubes *8* outside which steam from a pipe *9* circulates. This heating brings about incipient coagulation of the albumens and other heat-coagulable matter. Pressure may also be employed. In some cases, preliminary cooling instead of heating may be necessary; the juice then passes through a pipe *7*, having a control valve *10*, to the chamber *11*, where it is treated by agitation and neutralization. The chamber *11* is provided with an open ended tube *13* in which is situated, preferably towards its lower end, a propeller *14* mounted on a shaft *15* driven by means of a pulley *18*. The propeller *14* causes movement of the liquid down the tube *13* and thence up outside the tube, where staggered mixing vanes *20* may be provided. A suitable heating means, such as a steam coil *12*, in the base of the chamber *11* permits the temperature of the liquid to be maintained near or slightly below that at which it enters the chamber. An alkaline reagent, such as ground quicklime or slaked lime, or a dilute suspension or solution of milk-of-lime or calcium sucrate, is sprayed gradually into the circulating liquid. The reagent may be supplied from a container *24*, through pipe *25*, to spray-heads *27*. The condition of the liquid is inspected by means of a by-pass conduit *19*, the transparent portion *28* of which is filled with the liquid by opening valves *21*, and then separated by closing the lower, or both valves and observing the rapidity of settling of the solids and the colour of the liquid. The liquid is usually found to filter easily and to be without dicoloration at approximately *pH* 6·5 to 8, and may then be drawn off through a pipe *22* by operating a valve *23*. An inert material, e.g., brick dust, may in some cases be added to the liquid to aid coagulation and settlement of the impurities. The process is intermittent, but may be made continuous by suitably controlling valves *10*, *23*, and continuously supplying the reagent. The treated liquid may be filtered, or allowed to settle and decanted.

PRODUCTION, REVIVIFICATION, OR APPLICATION OF ACTIVATED (DECOLORIZING) CARBONS. (*A*) ***Artificial Coal Co.*** (***Hamon Process***)***, Ltd.***, and ***Count L. de W. Hamon***, of Park Square, London. *246,954*. December 2nd, 1924. (*B*) ***H. H. Ward***, of All Souls' Place, London. *247,364*. January 22nd, 1925. (*C*) ***J. Sauer***, of 2, Den Texstraat, Amsterdam. *247,241*. August 13th, 1924. (*D*) ***Vereinigte Chemische Werke A.-G.***, of Charlottenburg, Germany. *247,560*. February 9th, 1926; convention date, February 12th, 1925. (*E*) ***E. Goutal*** and ***H. Hennebuite***, of Paris. *247,210* February 5th, 1926; convention date, February 9th, 1925.

(*A*) A mixture of lime, magnesia or other alkaline earth, and the pulp waste obtained in the manufacture of paper, with or without the addition of air-dried peat or other carbonaceous material is heated until it is carbonized, and the resulting active carbon is freed from alkaline earth by means of acid, washed with water and dried. An internally or externally heated stationary or rotary retort may be employed. (*B*) A mixture of dried ground peat and dried bone-meal is carbonized in a retort, the carbon produced being cooled by means of cold water while it is being discharged after being kilned. (*C*) Particles of active carbon are coated or impregnated with a supplementary active carbon or an inorganic adsorbent material. The supplementary active carbon is produced by impregnating the base of active carbon with a carbonizable solution, carbonizing and finally activating by means of gas or other known chemical activating agents, while the supplementary inorganic adsorbent is produced by precipitation *in situ* within the pores of the active carbon base, followed by careful drying and heating. To prevent loss of absorbing power of the active carbon base, substances producing gases may be added;

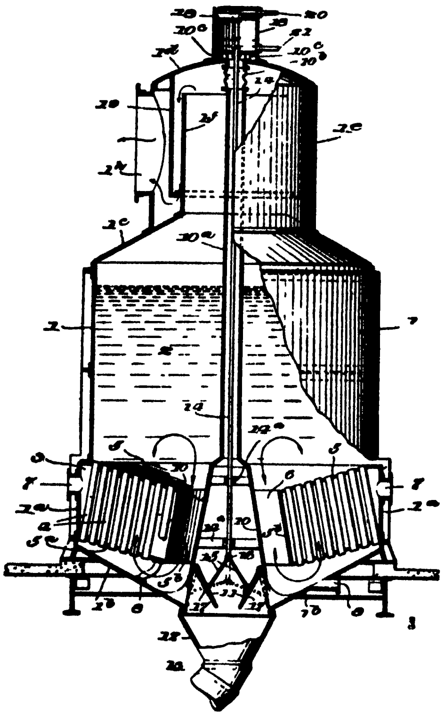
for example, prior to impregnation the base may be treated with benzol or other volatile liquid, or yeast or ammonium carbonate may be added. In an example an active carbon of low apparent specific gravity is treated with water-glass and hydrochloric acid is added so as to produce progressive gelatinization of silicic acid. On carefully drying and heating a hard product of increased specific gravity is obtained. In a second example an active carbon is mixed with sulphite cellulose lye and lime or calcium carbonate and the mass carbonized and subsequently activated. Before carbonization the mass may be moulded and subjected to pressure whereby granules, tablets, etc., may be produced. Silica gelt resulting from the hydrolysis of silicon chloride, oxides of aluminium and iron, insoluble or sparingly soluble salts of calcium, as oxalates, phosphates, citrates, and aluminates, are mentioned as other suitable supplementary adsorbents when prepared under conditions producing a highly adsorbent product. Different inorganic adsorbents may be applied successively or simultaneously and the active carbon base and the supplementary adsorben. may possess complementary powers. (Specifications 213,939 and 213,940 are referred to) (*D*) The decolorizing property of activated carbons is improved by grinding, this operation preferably being effected in the presence of water and continued until the particles are reduced to less than 1·5 micro-millimetres in size. (*E*) A product having great resistance to disintegration is obtained by carbonizing below 700° C. a mixture of carbonaceous materials which shrink on carbonization with those showing little shrinkage, e.g., cokes and carbon from nut shells etc , in the presence of hydrogenized tar and pitch products, e.g. such (as described in Specifications 231,863 and 241,899) ; to 20-70 parts of lignite coke, or of charcoal carbonized above 800° C. are added 80-30 parts of charcoal calcined below 550° C. and the mixture agglomerated with 30 per cent. of a tar pitch extracted from pyroligneous liquid and carbonized about 600° C. The product may be used for absorption and catalytic purposes.

Yaryan Type Evaporator. *E C R. Marks* (communicated by the *Swenson Evaporator Co.*, of Harvey, Illinois, U.S.A.). *247,246.* September 13th, 1924. Vacuum evaporating apparatus of the Yaryan type described in Specification 14162/86 is constructed with the parts which contact with the liquid being evaporated of materials resistant to corrosion such as iron alloy containing 11-15 per cent. of silicon, or vitreous material such as glass. In any unit of a multiple-effect apparatus, inlet headers are connected to outlet headers by a series of tubes formed of corrosion-resistant iron alloy contained in a heating-casing formed of steel. Liquid and vapour are discharged from the header into a vapour separating chamber containing baffles.—Fermenting Cellulose (as in Bagasse, etc.). *H. Langwell. 248,795.* September 10th, 1924. In fermenting cellulosic materials, the hydrogen-ion concentration in the mash is maintained substantially between the limits 10^{-9} and 10^{-6} by the use either of alkalis, metals or alkaline earths, the suitable compound being in the latter case added at appropriate times to precipitate an insoluble alkaline earth metal compound by reaction with the soluble alkaline earth metal compound produced by the neutralization. Concentration of cellulosic material in the mash is preferably not less than 5 per cent., and the material may be such that the addition of nutrients or of an inoculant may be dispensed with. Fermentation may be carried out with or without stirring, under aerobic or anaerobic conditions, or under reduced pressure. Products comprise alcohol, acetic acid, butyric acid, methane, hydrogen, and carbon dioxide, the relative proportions being controllable to some extent by varying the amount of nutrient. Examples are given. [Specification 134,265 is referred to].—Wood Substitutes made from Fibrous Material. *G. M. Clark* (communicated by *Agasote Millboard Co.*, of Ewing, New Jersey, U.S.A.). *248,800.* September 15th, 1924. Fibres and "red gum" xanthorrhea resin are mixed and moulded under pressure and heat. According to an example, 100 parts of wood fibre, 100 parts of comminuted red gum, and 5000 parts of water are mixed in a beater, the pulp run into a mould, and most of the water removed by pressure, for example as described in Specification 7301/08. Then the dried board is subjected to a temperature of 300°F. and a pressure of 300 lbs. per sq. in.

UNITED STATES.

Calandria Vacuum Pan, with Heating Element low down. *Clarence White*, of San Francisco, Cal., U.S.A. *1,558,957*. October 27th, 1925.

One of the objects of this invention is to provide a calandria vacuum pan having such a general shape and interior construction that the heating element may be positioned in the lowermost part of the pan and yet be sufficiently large to function satisfactorily. Another is to provide for improved circulation. Referring to the drawing which shows a pan embodying the main features of the invention, *1* is the cylindrical shell of the vacuum pan having the interior liquor chamber *2*. The lower portion of the shell has an outwardly flared bulge with an encircling wall *1*ª which accommodates the heater portion of the apparatus. Bottom floor of the pan is indicated at *1*ᵇ, extending with a sloping surface downwardly and centrally. The roof extends from the encircling cylindrical shell with an upwardly and centrally inclined surface *1*ᶜ. The topmost cover of the roof portions is indicated at the curved surface *1*ᵈ which caps an upper cylindrical portion *1*ᵉ. In this *1*ᵉ is a tortuous trap-like outlet passageway formed by an upwardly projecting extension *1*ᶠ, leading from the upper edge of the roof *1*ᶜ, and terminating close to the inner under surface of the top cap *1*ᵈ. A complementary downwardly projecting baffle member, *1*ᵍ hangs from the under surface of the cap *1*ᵈ and encircles member *1*ᶠ, with the result that vapours led off must go over the top of the baffle member *1*ᶠ, thence downwardly between *1*ᶠ and *1*ᵍ, and thence upwardly again to escape out through discharge opening *1*ʰ. The heater portion provides the bulge having the outer encircling wall *1*ª. Just within this *1*ª is an annular space *3* which extends completely around the interior surface of *1*ª and is the result of the inclination of the encircling tubes *4*, through which latter the sugar liquor passes from the under surface of the heater element through the heater to the upper surface of the heater element. The heater element includes a top plate *5*, also a complementary lower plate *5*ª, both of which are truncated cones having their smaller ends downward; *5* and *5*ª are positioned parallel to each other and thus spaced apart by the distance of a connecting well wall *5*ᵇ which connects with the inner marginal edge of the upper and lower members. The heater element is peculiar, in that the upper opening is smaller than the lower opening and the well wall *5*ᵇ thus slopes centrally upwardly. The circulating tubes *4* are inclined obliquely with respect to the outer walls *1*ª, but substantially parallel with the well wall *5*ᵇ. The central well wall *5*ᵇ provides the well space *6*. Steam is led in through openings *7*, and spent steam is led off through pipe *8*. Syrup or molasses is drawn in through *9* The central displacement core or bulge in the bottom of the pan is indicated at *10* as having a fluid-tight connexion with the margin of an opening in the floor *1*ᵇ. Core *10* projects upwardly substantially as a cone with its side walls substantially parallel to the well wall *5*ᵇ. The core at a point about at the top of the heater element is reduced in size and is extended as a tube *10*ª upwardly throughout the height of the pan and is in ported communication with the atmosphere. In order to provide for differences in expan-



sion, the tube *10*ª is provided with a short corrugated section of relatively light metal as indicated at *10*ᵇ. Outlet openings are provided at *10*ᶜ. Two foot valves are shown at *11* positioned at the lowermost point of the central core *10* and closing outlet openings formed in the lower portion of the wall of the core *10*. At the bottom of the pan is a "catchall" in the shape of a funnel-like member *12* through which the material of the strike is discharged downwardly into a pipe or discharge spout *13*. Operating means for controlling the outlet valves of the pan is provided by a rod *14* which extends downwardly from above the pan, through the length of the tube *10*ª to a point adjacent the bottom of the pan where it branches with short extensions *15*. Power means for moving the rod *14* is provided by a cylinder and a piston mounted on the top cap *1*ᵈ of the vacuum chamber. Steam or compressed air applied alternatively as the case may require to the pipes *20* and *21* provides sufficient power to open or close the foot valves *11*. In a modification the central core and the wall of the well of the heater element are substantially vertical, the central core being substantially the height of the heating element, and being continued in the upper reduced tube which communicates with the space above the vacuum pan.

PROCESS OF EXHAUSTING MUD IN THE CLARIFICATION OF CANE JUICE, ETC., BY LIME.

Rafael Vachier, of Baton Rouge, La., U.S.A. *1,578,220*. March 23rd, 1926.

A process is described for "de-sugarizing" defecation mud, so as to bring it to the lowest possible sucrose content previous to its coming into contact with water for its final exhaustion. It comprises a system involving separately treating the juice coming from each of the milling units, thus giving a series of juices decreasing in density and sucrose content. Referring to the drawing, *10* designates a crusher from which the cane is passed to the first mill *11*. The thin-juices extracted in the first mill are carried downwardly through a screen *12* to a heater *13* and lime is added to them as they enter the heater. They are conducted to the clarifier *14*, where the mixture is separated into a clear juice which is carried off through a pipe *15* to an evaporator. The mud separated in the clarifier is conducted through pipe *16* to the heater *17* of the second mill or stage in the process. The second mill *18* delivers the thin-juice to its screen *19* and thence to the heater *17*, a quantity of lime being added to this thin-juice from the second mill. The mud from the pipe *16* or the first stage is here admixed with the second thin-juice and lime, is heated and then conducted to the second clarifier *19*. This second admixture is separated into a clear juice, which is carried off through a pipe *20* to an evaporator, and the mud which is carried off through the pipe *21* to the heater *22* of the third mill *23*. In a similar manner the third mill has a screen *24* through which the third thin-juice is,

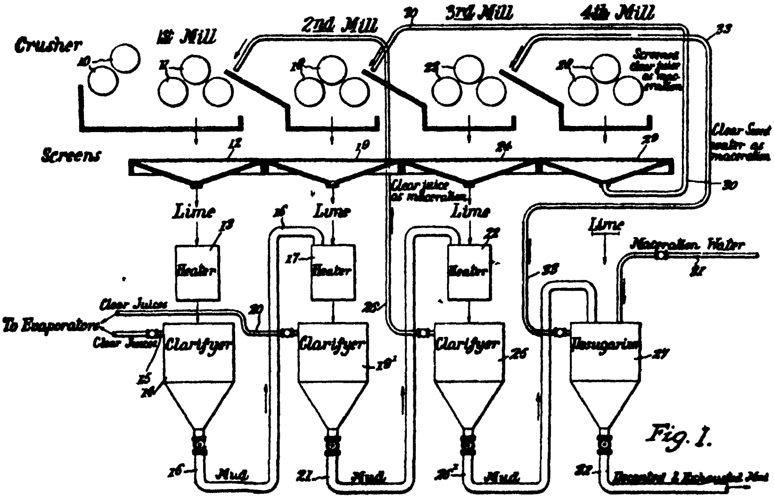


Fig. 1.

strained, after which it is limed and conducted to the heater *22*, and finally to the third clarifier *25*. The clear juice from the third clarifier *25* is conducted through pipe *26* and delivered as maceration in front of the second mill *18* (although this is optional). The mud from the third clarifier *25* is conducted through pipe *26* to a "de-sugarizer" *27* used for the final extraction of the sucrose content from the mud The fourth mill or stage *28* delivers its thin-juice through the screen *29* to a pipe *30* for conducting this last thin-juice as maceration to a point in advance of the third mill *23*. This, of course is an optional arrangement, as is also the four-stage mill, as any number of stages may be employed. The de-sugarizer *27* receives the mud from the third clarifier *25* and receives a quantity of lime for admixture therewith and with maceration water from pipe *31*. The decanted and exhausted mud from the de-sugarizer *27* is carried off through pipe *32* and is practically completely de-sugarized and may be used as fertilizer or the like, it having no further sucrose content. The clear sweet-water which is separated out in the de-sugarizer is conducted through pipe *33*. This clear sweet-water carried off through pipe *33* is used as maceration in front of the fourth stage or mill *28* and obviates the necessity of applying an additional or extra amount of water as maceration in front of the various stages or mills during the process. It will be seen that the only water added is in the de-sugarizer and that by this process the mud is consecutively reduced in sucrose content throughout the various stages of the mill, and is finally and practically completely exhausted of its sugar content by the water of maceration and lime, which is added in the de-sugarizer or in the last stage of the process. Even from the de-sugarizer, the clear sweet-water is collected and made use of as maceration, so that there is practically no waste use of the water which is used during any stage of the process.

Process for the Electro-Osmotic Purification of Saccharine Juices, Syrups, etc. *Kuno Wolf and Egon Langstein* (assignors to *American Electro-Osmosis Corporation*, of New York). *1,577,669*. March 23rd, 1926. Claim is made for the process of purifying saccharine juices which consists in submitting an aqueous solution thereof to the action of an electric current with the solution separated from the electrodes by semi-permeable diaphragms, the anodic diaphragm being leather impregnated with quinone and the cathodic diaphragm being sail cloth.—Manufacture of Dextrose (Grape Sugar). *Wm. B. Newkirk*, of Riverside, Ill., U.S.A. *1,571,212*. February 2nd, 1926. Claim is made for obtaining grape sugar from a dextrose and water solution produced by the conversion of starch, which comprises concentrating the solution to supersaturation by heating, cooling the solution and maintaining the same at a temperature favourable to the production of anhydrous crystals, separating the mother-liquor from the dextrose crystals, holding the mother-liquor at a lower temperature to induce the growth of hydrate crystals, and separating the mother-liquor from the second batch of crystals.—Filtering Medium. *Edward M. Knight*, of Brooklyn, N.Y., U.S.A. *1,571,417*. February 2nd, 1926. Comprises three layers of material maintained in a horizontal position, two outers of fibrous material, and one inner of carbon.—Beet Topper. *Abilio F. Garcia*, of Santa Clara, Cal., U.S.A. *1,577,742*. March 23rd, 1926. Claim is made in a beet topper for a table, a cutter element operatively mounted parallel with and in close proximity to the bottom thereof, a belt operatively mounted on the table to move in a plane parallel to the cutter and adjacent thereto, spaced beet engaging elements mounted on said belt and arranged to support the beets at right angles to the cutter, resilient means mounted in opposed relation to said belt and adjacent to said cutter and adapted to engage the beets carried thereby, and means for operating the belt and cutter in co-ordinate relation with each other.—Use of Kieselguhr for Dehydrating. *A. L. Elsenbast* (assignor to *The Celite Company*). *1,570,626*. January 26th, 1926. Small quantities of water are separated from non-aqueous liquids by admixture with dehydrated kieselguhr, followed by filtration.—Prevention of the Deterioration of Sugar. *Wm. L. Owen*, of New Orleans, La. Dedicated to the People of the United States. *1,579,387*. April 6th, 1926. Claim is made in a process for the preservation of white sugar, for the step of inoculating such sugars with torulæ yeast.[1]

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[1] See *I.S.J.*, 1923, 371; also 1926, 198-203. A fuller abstract of this Patent will be given later.

Sugar Crops of the World.

(*Willett & Gray's Estimates to May 27th, 1926.*)

	Harvesting Period.	1925-26. Tons.	1924-25. Tons.	1923-24. Tons.
United States—Louisiana	Oct.-Jan.	175,000	79,002	144,664
Texas	,, ,,	—	—	—
Porto Rico	Jan.-June	525,000	589,760	399,975
Hawaiian Islands	Nov.-June	645,000	692,804	626,279
West Indies—Virgin Islands	Jan.-June	7,000	7,200	2,332
Cuba	Dec.-June	4,900,000	5,125,970	4,066,642
British West Indies—Trinidad	Jan -June	55,000	69,628	52,045
Barbados	,, ,,	45,000	49,315	44,109
Jamaica	,, ,,	57,675	42,843	34,334
Antigua	Feb.-July	15,000	14,632	7,860
St. Kitts	Feb.-Aug.	13,000	15,563	10,196
Other British West Indies	Jan.-June	7,500	9,000	4,488
French West Indies—Martinique	Jan.-July	45,000	47,995	17,110
Guadeloupe	,, ,,	40,000	39,990	27,548
San Domingo	Jan.-June	350,000	311,270	229,373
Haiti	Dec.-June	13,500	8,280	5,800
Mexico	,, ,,	175,000	165,223	166,932
Central America—Guatemala	Jan.-June	25,000	25,562	20,850
Other Central America	,, ,,	62,500	73,240	55,281
South America—				
Demerara	Oct.-Dec. and May-June	102,000	90,874	95,494
Surinam	Oct. Jan.	10,000	10,200	10,682
Venezuela	Oct.-June	19,000	19,000	17,488
Ecuador (1926-27 18,000)	Oct.-Feb.	16,976	18,700	13,662
Peru	Jan.-Dec.	265,000	310,522	316,904
Argentina (1926-27 375,000)	May-Nov.	395,733	246,717	249,162
Brazil	Oct.-Feb.	650,000	812,493	799,931
Total in America		8,614,884	8,875,783	7,419,141
Asia—British India	Dec.-May	2,923,000	2,548,000	3,317,000
Java (1926-27 : 2,005,500)	May-Nov.	2,278,900	1,977,490	1,771,772
Formosa and Japan	Nov.-June	498,460	458,836	448,736
Philippine Islands	,, ,,	425,000	581,064	372,332
Total in Asia		6,125,360	5,565,390	5,909,840
Australia (1926-27 450,000)	June-Nov.	522,344	435,680	281,859
Fiji Islands	,, ,,	90,000	100,810	63,898
Total in Australia and Polynesia		612,344	536,490	345,757
Africa—Egypt	Jan.-June	107,000	110,000	88,382
Mauritius (1926-27 200,000)	Aug.-Jan	232,700	224,710	201,550
Réunion	,, ,,	59,130	52,380	44,132
Natal (1926-27 : 223,000)	May-Oct.	213,807	143,974	181,558
Mozambique	,, ,,	70,000	44,278	56,400
Total in Africa		682,637	575,342	572,022
Europe—Spain	Dec.-June	9,000	8,087	7,871
Total cane sugar crops		16,044,225	15,561,092	14,254,631
Europe—Beet sugar crops		7,460,403	7,078,490	5,057,761
United States—Beet sugar crop	July-Jan.	804,439	974,185	787,217
Canada—Beet sugar crop	Oct.-Dec.	32,475	36,200	16,500
Total beet sugar crops		8,297,317	8,088,875	5,861,478
Grand total Cane and Beet Sugar	Tons	24,341,542	23,649,967	20,116,109
Estimated increase in the world's production	,,	691,575	3,533,858	1,962,853

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1926. Tons.	1925. Tons.
Total Receipts, January 1st to May 26th	1,596,262	1,609,359
Deliveries ,, ,,	1,415,690	1,502,511
Meltings by Refiners ,, ,,	1,306,000	1,386,930
Exports of Refined ,, ,,	50,000	75,000
Importers' Stocks, May 26th	189,228	106,848
Total Stocks, May 26th	366,196	237,786
	1925.	1924.
Total Consumption for twelve months	5,510,060	4,854,479

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924. Tons.	1925. Tons	1926 Tons.
Exports	1,891,350	2,185,378	1,751,982
Stocks	940,715	1,158,245	1,452,147
	2,832,065	3,343,623	3,204,129
Local Consumption	40,000	60,000	45,000
Receipts at Ports to April 30th	2,872,065	3,403,623	3,249,129

Havana, April 30th, 1926. J. Guma.—L. Mejer

Beet Crops of Europe.

(Willett & Gray's Estimates to May 20th, 1926.)

	Harvesting Period.	1925-26. Tons.	1924-25. Tons.	1923-24. Tons.
Germany	Sept.-Jan.	1,600,000	1,575,684	1,146,891
Czecho-Slovakia	Sept.-Jan.	1,520,000	1,409,703	1,001,049
Austria	Sept.-Jan.	80,000	75,443	47,321
Hungary	Sept.-Jan.	162,000	202,354	122,588
France	Sept.-Jan.	755,000	827,472	490,850
Belgium	Sept.-Jan.	335,000	400,105	300,121
Holland	Sept.-Jan.	310,000	329,244	231,923
Russia (Ukraine, etc.)	Sept.-Jan.	1,041,903	458,375	366,742
Poland	Sept.-Jan.	590,000	494,854	389,995
Sweden	Sept.-Dec.	204,500	135,270	153,890
Denmark	Sept.-Jan.	175,000	140,000	102,358
Italy	Aug.-Oct.	162,000.	422,000	351,102
Spain	Sept.-Jan.	225,000	260,000	185,063
Switzerland	Sept.-Jan.	6,395	5,906	5,896
Bulgaria	Sept.-Jan.	38,000	39,758	26,566
Roumania	Sept.-Jan.	110,000	86,256	71,826
England	Sept.-Jan.	51,140	23,730	13,280
Other Countries	Sept.-Jan.	94,465	191,907	50,300
Total in Europe		7,460,403	7,078,051	5,057,761

United Kingdom Monthly Sugar Report.

Our last report was dated the 14th April, 1926. No report was issued in May owing to the General Strike.

The market during the two months has been quiet but steady and generally speaking prices are higher than two months ago, although the strike had a detrimental effect on the distribution of sugar and the coal strike is still interfering with the refiners, manufacturers and the transport.

The London Terminal Market remains quiet in consequence of the large stocks in London and since the strike business has not been in such large volume as formerly. About 35,000 tons were tendered on May contracts, and this month was finally liquidated at 14s. 1⅛d., having fluctuated during the month from 13s. 9d. to 14s. 3¾d. Large quantities of May, however, were transferred to August and December. A big business was done in August from 14s. 4⅛d. to 15s. to 15s. 5¼d to 14s. 10½d. to 14s. 6¾d. Considerable interest has been shown in new crop and a fairly large business has been done in December from 14s. 6d to 15s. 3¾d. to 15s. October and November have also been traded in but are not such popular months as December. Deliveries for 1927 have proved attractive and a fairly large business has been put through in March from 14s. 10⅛d. to 15s. 6¾d. to 15s 3¾d., and recently in May from 15s. 9d. to 15s. 6¾d.

Trading in actual sugar has been slow and the demand from the trade has been poor. Dealers are still adopting a hand to mouth policy and are only buying as they are obliged.

Although stocks in exporting European countries appear to be large, no pressure has been experienced and a good many of the Czecho Refineries have little left for sale of the old crop. Ready Czecho Granulated sold from 14s. to 14s. 10½d. to 14s. 7½d. f.o.b., June sold at 14s. 9d., and July/August at 15s., whilst Dutch Granulated has usually commanded 1⅛d. to 3d. per cwt. more money. American Granulated has only been sold in small quantities and the latest price is 15s. 7⅛d. c.i.f. White Javas for May/June shipment have been too high for this market, the quotation being 15s. 9d. c.i.f. Spot Granulated in London has been sold at 27s 1⅛d. to 27s. 7⅛d. Mauritius is now getting scarce and small parcels have been sold from 25s. 6d. to 25s. 3d. according to quality.

The Home Grown factories have now completed the sale of their 1925–26 crop, and it is estimated that the English crop next year will be between 100/120,000 tons.

The British Refiners have done a fair business although greatly hampered by the strike. On April 15th their prices were advanced by 6d. per cwt., on April 22nd Granulated was advanced 3d. and Cubes 6d. per cwt., again on May 17th their prices were further advanced by 3d., and on June 2nd their prices were reduced by 6d. per cwt. The latest prices are No. 1 Cubes 33s. 3d., London Granulated 29s. 1½d., duty paid.

The British Refiners have been comparatively small buyers of raws owing to their big stocks and also in consequence of the strike. Business was done in Cubans and San Domingos at 11s. 6d. c.i.f., and a Mauritius cargo was sold at 16s. 3d. c.i.f. Several cargoes of Cubans have been sold to the Continent from 11s. 6d. to 11s. 7½d.

In New York a fairly large business has been done to the American Refiners and latterly the Cuban has not been so anxious a seller. The price advanced from $2\frac{5}{16}$ to $2\frac{11}{32}$. The latest price is 2⅜ c.i.f. New York.

The Futures market has fluctuated with raws but on the whole quotations are not materially changed compared with two months ago.

A scheme to reduce the Cuban crop by 10 per cent. was proposed by a Committee of those interested in sugar in Cuba. This was finally adopted by the President and the Senate and eventually became law. Under this scheme no Central under penalties was allowed to produce more than 90 per cent. of their estimate, and the crop in consequence was to be limited to 4,750,000 tons. However, the figure now generally accepted is 4,900,000 tons, or a reduction of 200,000 tons on the last crop. Another provision of the Bill is that no Central may start grinding until a certain date to be fixed by the President in each year, also future plantings are to be restricted. The stock at the ports to date is 1,409,000 tons against 1,255,000 tons a year ago.

With regard to Europe, Germany has so far not been a general exporter of sugar, although France has taken 50/60,000 tons by way of reparations. F. O. Licht has not materially altered his estimate for the sowings, but it is generally understood from private sources that there will be a larger decrease in Germany, Czecho Slovakia, Holland, Belgium and Poland than previously expected. It is already reported that Russia has reduced her sowings by 20 per cent.

21, Mincing Lane,
London, E.C. 3.
June 8th, 1926.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 331. JULY, 1926. Vol. XXVIII.

Notes and Comments.

The Anglo-Dutch Group of Beet Sugar Factories.

Last month four of the leading beet sugar factory companies of the Anglo-Dutch group in this country held their annual meetings, and three of them were able to announce a profitable year. The English Beet Sugar Corporation which runs the Cantley factory (the oldest one in the country), after providing for all charges including depreciation and income tax, and transferring £93,719 to general reserve, showed a balance of net profit amounting to £56,313; and a dividend of 12½ per cent., free of tax, upon the preference and ordinary shares was declared. Ipswich Beet Sugar Factory, Ltd., had a successful first season, so that after providing for the usual charges, and transferring £1443 to general reserve, there remained a balance of net profit of £12,500, from which a dividend of 5 per cent., free of tax, on the ordinary shares was declared. A third factory, the Ely Beet Sugar Factory, Ltd., was able to transfer £6065 to general reserve and show a balance of £15,000, which was applied to the payment of a dividend on the ordinary shares of 6 per cent., free of tax. Only Kelham, the factory of Home Grown Sugar, Ltd., failed to earn enough to pay a dividend in full. After providing for all charges and for interest on mortgages there was a credit balance of £22,455. But to allow for depreciation and to pay a dividend of 5 per cent. on the public shares, £4156 had to be borrowed from the general reserve fund. It should, however, be added that the original amount at mortgage was £300,000; of this £70,000 has already been paid back out of revenue; £75,000 is to be paid shortly as a result of the sale of the adjacent Kelham estate; and before very long it is expected that the only remaining mortgage will be the £125,000 lent by the Government. The charge for mortgage interest will thus be materially reduced in future.

It will of course be argued that with the big subsidy available it would be difficult for the factories not to show a profit; but the difference between the ample profits of the longer established Cantley factory and the moderate returns of the two newer concerns, shows that in the absence of the subsidy it would be hopeless for the latter to avoid a heavy loss in their inaugural years when the various stages of operation lack through inexperience (and also weather vagaries) that degree of synchronization that goes to economical working. Hitches are bound to occur in the experimental years and some of them prove necessarily expensive. Last season deliveries, due to the unexpected spell of frost in November, were irregular, and it was even necessary to transfer to other factories of the group a proportion of the deliveries of roots and thus enable individual factories to close down for the season before operations became unremunerative. Cantley took the last portion of the Kelham roots, while Ipswich, struggling with the difficulties of a first season in a factory very hurriedly constructed, had to send elsewhere over 40 per cent. of the roots received from the growers; these last, it may be noted, included a consignment from 293 growers in the Yeovil district of Somerset. Leaving aside the question of how far a total absence of the subsidy would affect the Cantley figures, it may be said that the factory seems well established; Kelham seems to be emerging at length from the difficulties that have hampered its first few campaigns; but Ely and Ipswich have a considerable advance to make before it is possible to judge what a normal season is going to be with them. They have at all events avoided the depressing effect of a loss on the season's working.

Their Future Outlook.

The various remarks of the Chairmen of the several meetings on the outlook for their respective companies may be noted in this connexion. The chairman of the English Beet Sugar Corporation, answering the suggestion that they would be unable to carry on when the payment of a subsidy ceased, said that it was unlikely that after the costly experience of the past their shareholders (largely Dutch) would continue to invest money in the industry with all the risks attendant to it, if they did not intend to operate the Cantley factory as a permanent market for its growers. As for Ely, it has had to depend largely on foreign capital and foreign expert help, as English capital was shy of investing in the industry; this Dutch assistance could be regarded as a fair guide to the view taken of the possibilities of permanence for the new industry. Both at the Cantley and the Ipswich meetings reference was made to the attempts on the part of opponents of the industry to create doubts and disaffection in the minds of the parties interested, especially the farmers and the financial houses. Sir G. L. COURTHOPE, BART., M.P., described some of the critical propaganda as "a mass of misleading literature, issued either by opponents of the industry or by those who wished to pose as experts but had neither experience nor knowledge." The fact that City financial circles have been shy of beet ventures has not, however, affected the fortunes of this group, as Dutch financial interests readily found the money necessary for both Ipswich and Ely; and neither company has had to ask for capital in this country guaranteed under the Trade Facilities Act.

Report of the West Indian Conference.

A Conference of representatives from the British West Indies, British Guiana, and British Honduras, which was convened a short while ago by the Secretary for the Colonies to consider the establishment and draft the constitution of a Standing Conference, to deal with the common affairs of these colonies, has just lately issued its report.

Recognizing the value to that region of the British Empire of past periodical conferences (among which the agricultural ones are best known to our readers), there has sprung up a desire in responsible quarters for some sort of central council that would meet from time to time; a purely advisory body with no executive powers, albeit one capable of putting forward a definite West Indian opinion for the information of the Imperial Government (an opinion that has till now been lacking to the great loss of these colonies) and possibly entitling it in due course to a vote in the deliberations of the Imperial Conference, thus at length raising the West Indies to their proper status in the Empire.

The Report fully recognizes the value of such a standing conference of West Indian representatives, and recommends that the eight colonies concerned should form one under the title of the "West Indies Conference." This should consist of an agreed number of representatives from each colony who should be as far as possible members of their respective Legislatures or Governments. The voting, the Report recommends, should be by individuals; as for the meeting place, it is suggested that it should be alternately London and one of a rota of West Indian centres; the former offers the greater opportunity of impressing West Indian opinion upon the home authorities, while the West Indies offer the greater opportunity of developing a West Indian consciousness. Since summer is the best time for London and winter that for the West Indies, intervals of 18 or 30 months between each conference suggest themselves, and the Report recommends after careful investigation that 30 months should accordingly be the normal interval between the meetings. The subjects to be discussed will include Agriculture, Aviation, Banking, Commercial, Defence, Education, the Imperial College, Law, Marketing of Produce, Medical, Public Utility Services, Tourist Trade, and Trade Representation. The initiation of subjects is, however, to be confined to the Secretary of State and the constituent Governments in consultation with their legislatures, and not to be accorded to outside individuals; members of the Conference would, however, be allowed to raise topics subject to the approval of a majority of the members. It is recommended that a permanent secretary be appointed to organize the conferences and circulate the information, and keep in touch with specialized conferences, so that their proceedings may if necessary be brought to the attention of the Standing Conference. Finally, it is recommended that the first meeting of this new body might with advantage be held in Barbados in the winter of 1927-28.

If the recommendations of this report are accepted by the Imperial Government, as seems likely, there is little doubt that the inauguration of a series of conferences will be beneficial in finding a common ground amongst any divergent elements of these rather scattered units of the Empire. From a purely advisory body it may, if it justifies its existence, ultimately develop into a legislative one, embracing those aspects of colonial government which are not purely local but inter-colonial, much as in the United States there are local State laws, and also laws and regulations that cover the whole group of individual States. The scattered nature of the units of our Empire centred on the Caribbean Sea has hitherto proved an insurmountable obstacle to co-operation in government, jurisdiction, and commerce. But now that aviation is becoming every year a more feasible proposition as a means of communication, it does not seem unreasonable to assume that before many years more have passed, inter-island transport will become as commonplace through aeroplanes as has land transport thanks to long distant railway lines.

The Fulton-Farrel Lawsuit.

After considerable delay, that seems inevitable where the Law is concerned, a United States Court has decided that the Farrel Foundry & Machine Co's Double Crusher device does not infringe the patent granted to O'NEIL in 1919 and transferred by him to the Fulton Ironworks Company. The grounds of the decision are set forth in some detail on another page. Briefly put, the Court decided that the patent was really anticipated by the Krajewski Crusher patent of 1886, and that there was no invention involved in multiplying pre-crushers before a mill, especially as one set did not modify to any material degree the action of the other set, so it only amounted to mechanical duplication. Finally, it was shown that in two salient respects the defendant's device did not correspond in action to that of the plaintiff, and so could not be claimed to have infringed it.

This decision, which is not altogether unexpected, will doubtless be welcomed by all those engineering firms who have devised pre-crushing equipment on the same duplicating lines, since if the Fulton claim had been upheld it would probably have resulted in legal decisions being obtained against other parties. But it may be pointed out that patent law procedure is not quite the same thing in the United States as in this country and some others. In America, if we understand aright, it is very much the custom to get a patent first and then establish its validity, if afterwards challenged, by means of the courts of law. In England the Patent Office exercises a certain discretion in the matter of validity before it decides to grant a patent, and time is allowed for objections to be raised, so though the grant of a British patent is not legal proof of validity, it tends to narrow down the number of cases where infringement of prior patents or non-patentability can subsequently be established in the Law Courts. In Germany and Holland the acceptance of a patent almost establishes its validity, so thorough are the authorities in examining its claims from different aspects.

The Future of the Double Crusher.

In view of this legal decision covering a particular design of double crusher, it may be not without interest to speculate as to what future the double crusher in general is likely still to command in modern sugar cane milling practice. On another page we publish a somewhat trenchant article from the pen of Dr. FRANCIS MAXWELL, dealing with this section of milling equipment; he takes the decisive line that there is no longer any use for this piece of apparatus in the light of more recent inventions; and he quotes a number of authorities, and instances the trend of view in some of the leading cane sugar countries in support of his contention. Whether or not our readers concur fully with Dr. MAXWELL, it will be agreed that he makes out a strong case for his argument. Our pages are however open to any competent writer who sees fit to controvert Dr. MAXWELL's conclusions.

It should not be overlooked, though, that the latter's knowledge and his opinions on the subject are greatly influenced as a result of a three years' tour which he recently took amongst a number of leading cane sugar countries of the world, during which he was able to acquire first-hand knowledge of the progress being made. Since Dr. MAXWELL undertook this tour entirely on his own initiative and at his own expense, he was able to spend a considerable time in each country and thereby to carry out exhaustive investigations in connexion with sugar factory practice. In addition Dr. MAXWELL had the privilege of meeting the Directors and staffs of the various Experiment Stations, as well as other leading sugar experts, and of discussing with them the most important changes and improvements which have been adopted in recent times in the sugar industry.

It may be added that while he was in the United States, Dr. MAXWELL took the opportunity to visit the beet sugar districts of California and Colorado, thereby acquiring an insight into American methods as compared with Continental and British ones. He is at present engaged in writing the results of these investigations, and we hope to publish them in the near future.

Notes and Comments.

Streak Disease in Maize.

The Uba cane, whose chief value lies, perhaps, in its immunity to sugar cane mosaic, appears to have its own variation of this disease, which, to prevent confusion has been termed "Streak." It is not mosaic but, none the less, a virus disease agreeing with it in many particulars. As might be expected, this hardy cane does not at present suffer so much from streak as most other canes do from mosaic; but on a conservative estimate it appears to diminish the crop by at least 10 per cent. in fully infected fields, and these are many in Natal. We have not as yet come across any report of streak in other countries; but it is more likely that, owing to the wide distribution of Natal Uba of late years, we shall soon hear of its occurrence elsewhere. In Natal, where very few other cane varieties are grown, streak has been already found on several of them, and is therefore worthy of a good deal of attention. The discoverer of the disease has lost no time in publishing the facts as they have come to light, so that, although the full history is not yet available, we have a very fair idea of the characters of streak and its importance as a new sugar cane disease. Great credit is due to STOREY for not withholding his discovery until he had made certain of all the scientific details; and last year we were able to give our readers a fairly full account of the disease built up chiefly from bulletins of the local Agricultural Department. We have lately received the first of a series of scientific papers on the subject, dealing with streak transmission in the maize plant. It is essentially a maize disease, for by all accounts it was known on that plant long before Uba was introduced to Natal; and we are therefore justified in considering that maize has handed it over to the sugar cane, although the actual transference has not been as yet described. This first paper, which was dealt with last month, must therefore be taken as an initial step in our study, and this is the reason why we introduced a purely maize paper into the Journal.[1]

Some Data on the Italian Sugar Industry.

Although the Italian Government has carried on quite a strong propaganda to encourage the growing of beetroot during 1926, inducing many agriculturists of the Padua valley to give the preference to this type of cultivation, the resulting harvest will be lower this year than had been foreseen. The area sown will reach about 82,000 hectares, being above that of the previous year, but much below the average.

The Italian sugar industry is passing through a period of noteworthy depression. The harvest of 1925-26 closed with a production of white sugar of 140,000 tons, in comparison with 375,000 tons in the preceding campaign (1924-25); 315,000 tons in 1923-24; 264,246 tons in 1922-23; 206,396 tons in 1921-22, and 296,945 tons in 1913-14. The situation of the Italian beetroot sugar industry is complicated, not only through the competition exercised on the world market by cane sugar, but also by the dumping system carried on by the Czecho-Slovak beetroot sugar industry. Even taking into account the new sugar factories started in 1924, it is apparent that the production of beetroots this year will not be equal to the needs of the industry.

The Italian sugar industry, as constituted to-day, consists of 35 limited companies, having a combined capital of 684,000,000 lire, or about £5,261,538.[2] The sugar factories number 55, of which 20 are in the Veneto region, 22 in

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[1] This "Note and Comment" was intended for insertion in our last issue simultaneously with the paper in question, but was accidentally overlooked. We give it now, as the explanation offered seems due to the reader.—Ed., *I.S.J.*

[2] £1 sterling = 130 lire.

Emilia, 4 in Lombardy, 1 in Piedmont, 1 in Liguria, 3 in Tuscany, 2 in Umbria, 1 in Latium and 1 in Abruzzo. Two of the factories are only refineries, while fifty-three are producers, fourteen having an adjoining refinery. The combined capacity of the fifty-three producing factories amounts to 47,000 tons of beetroots per twenty-four hours, and with an average harvest of seventy days 3,300,000 tons of beetroots can be treated, which are sufficient to cover the present annual needs in sugar of Italy and its colonies—a matter of 320,000 tons. The Italian sugar industry also possesses twenty-one drying factories for beetroot pulp and eight molasses distilleries. The present value of all the plants exceeds 1,000,000,000 lire or £7,692,307. The industry employs the whole year 9,000 persons both factory and field workers, and more than 25,000 workers in the period of the harvest.

Sugar Production in Palestine.

In a contemporary[1] some interesting particulars appear of an attempt to include sugar cane cultivation in the agricultural developments of Palestine. Its financial possibilities are beginning to be recognized, and a group of planters is already formulating extensive plans for their exploitation, Some sixty-four experiments have been made with sugar cane at Daganiah, a Jewish colony in Galilee, and from 12 to 15·3 per cent. of sugar was obtained, though the crop was no more than 50 tons of cane to the hectare, due to lack of adequate irrigation. Five of the best Egyptian varieties of cane have been experimented with, and the methods in use in Egypt would appear to be followed. These trials are being carried out by the Institute of Agriculture, supported by the Zionist Organization. The Lake region round the city of Tiberias is said to be ideal for the raising of sugar cane. Irrigation facilities are excellent, the climate is favourable, and the soil has the proper moisture.

But in Palestine generally, the leading problem that faces all agricultural enterprises, and particularly the new one of sugar cane, is the insufficient supply of water, only to be met by an adequate system of irrigation. Although the country is deluged with incessant rains for six months in the year, this is followed in the remaining six months by excessive heat and drought, when in the absence of facilities to store the water and conserve the moisture, agriculture is carried on with difficulty. Comprehensive plans of irrigation and reafforestation are being promoted by the Zionist Organization; 300,000 trees have been planted within the past five years.

It seems legitimate to suggest that this is the first instance in the long history of the Holy Land that sugar cane has been even experimentally grown, at all events on a field scale. The Bible in its references to the agriculture of its day makes no reference to any plant that can be identified as of the Saccharum genus. Just before the great war some authoritative statements were made in our pages[2] as to the correct interpretation of certain Bible phrases, supposed to designate the sugar cane. It may be of interest to quote once again the conclusions drawn. There is hardly any doubt in the mind of competent scholars that the expression "sweet cane," as found in *Isaiah* xliii, 24 and *Jeremiah* vi, 20, does not refer to the sugar cane, but (as Dr. PRINSEN GEERLIGS ascertained from some learned Hebraists) to an aromatic herb. It is the same phrase as occurs in *Exodus* xxx, 23-25, where it is translated as *Calamus* (*Acorus calamus*, the well-known "sweetflag" fragrant spice). Others have held that the "sweet cane" might have been the fragrant lemongrass of India (*Andropogon schoenanthus*). Others, again, have identified it with the bark of the cinnamon tree ; none admit that it can be the predecessor of the modern sugar cane.

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[1] *Sugar*, 28, No. 6 (June, 1926).

[2] *I.S.J.*, 1914, 150, 283.

Professor VON LIPPMANN has pointed out also that the sugar cane is not mentioned in the Talmud, the collection of Jewish traditional or oral laws which were originally handed down orally from generation to generation and had to be learnt by heart. In the sixth century A.D. it was published for the first time ; but the first reference to sugar cane does not appear till 900 A.D. After that the Jewish halachic works often referred to sugar cane, but there seems no evidence available as to whether any of these references related to the cultivation of the plant in that part of Asia.

Field Labour in Cuba Unsettled.

At the beginning of June Mr. HIMELY of Havana wrote to the *Federal Reporter*, pointing out that while the prospects of the next cane crop in Cuba looked auspicious, thanks to the copious rainfalls of April and May, which had benefited the sprouting stubble and the new plantings, yet "there is a latent dissolvent in the present situation, impairing to the best interests of the industry in Cuba where the *colono* system has proved itself, that arises within the *colono* himself; many of these passively neglect the cultivation of their fields, leaving them to run riot, whilst others, having lost all hope, willingly surrender their tenancies to the leasing sugar companies rather than persevere throughout another year." Such is more or less the status of the planters' sentiment after the passage of two bad marketing seasons that the sugar company can tide over, but which find the *colono* broke in purse and credit. No wonder he feels defeated and forced to cast about for something else. Yet the question imposes itself : What other agricultural crop with an equal commercial value can be substituted in the place of sugar cane, since none is more profitable or better suited to the natural conditions of Cuba ?

German Sugar Combines.

We referred in our April issue to a reported combine on the part of the vast bulk of the German sugar factories to finance a scheme of export for their surplus sugars. Another combine, this time of South German sugar factories, is reported in a recent issue of *Empire Production and Export*, the details being obtained by the Department of Overseas Trade at the special request of the B.E.P.O. At a meeting recently held at Heidelberg it was agreed that steps should be taken to fuse completely the sugar factories that have hitherto been united in the "Gemeinschaft Suddeutscher Zuckerfabriken (Association of South German Sugar Factories), viz., the factories of Frankenthal, Waghäusel, Stuttgart, Heilbronn a. Neckar, and Offstein, while the Rheingau factory at Worms, being already controlled by the Gemeinschaft, would also come in. It was contemplated that the fusion should be effected in a manner similar to that of the recent fusion in the chemical industry. The total capital of the new combine, if these proposals are carried through, will amount to about 30,000,000 marks. A subsequent meeting is reported to have unanimously adopted the proposals. The concern will be known as the "Suddeutsche Zucker Akt. Gesellschaft" and its headquarters will probably be at Mannheim. The main object of the fusion is doubtless to obtain increased efficiency and a reduction in working costs.

Mr. FRANK TWYMAN, F.R.S., Managing Director of the firm of Hilger, Limited, London, was recently honoured by the Franklin Institute, of Philadelphia, having been presented with the Wetherill Medals.

Fifty Years Ago.

From the "Sugar Cane," July, 1876.

The President of the Royal Agricultural Society of British Guiana had offered prizes, for the best essays on three topics of sugar production, and that which had won in the division of sugar manufacture was here reproduced. A few extracts from it appear worth while again printing: "The eyes of proprietors are now being generally opened to a full understanding of the economy of large powerful mills, and perhaps the day is not far distant when every mill will be condemned as wasteful that cannot press 95 per cent. from the canes that it crushes. . . . . The next step for consideration is the tempering and clarifying of the liquor. This, as a rule, determines the quality of the sugar. Liquor from ripe, fresh canes, cannot fail to make good sugar if properly sent to the copper wall unless it be spoiled by the grossest mismanagement or extraordinary accident. But an error in the clarifier loft is seen through all the subsequent stages of manufacture, and fixes the price at the sample-table of the broker. . . . . It is impossible on paper to give an idea of the correct quantity of lime to use. . . . . it is the most critical part of the manufacture of sugar. . . . . there is one exact quantity that is correct, the slightest excess or deficiency affects deleteriously the quality of the sugar. Canes of different age, different soil, or different time since cut, require different tempers. Canes allowed to lie too long between the cutlass and mill at once declare their damaged condition in the clarifiers, even if it has escaped detection previously. . . . . The copper wall is a very extravagent method of boiling sugar, the loss from charring and evaporation being very great. After the syrup has been taken from the copper wall . . . . . it is either subsided or filtered, or both. The most experienced planters differ as to the best method of treating syrup, and all have excellent reasons in favour of their favourite method. The subsiders maintain that no system of filtering, except through animal charcoal, can give as clear syrup as subsiding does, and that the use of animal charcoal is so expensive in this colony as to be out of the question. The filterers maintain that syrup undergoes a chemical change during subsidence, losing the bright sparkling look it should have, and acquiring a certain oiliness or clamminess, and that a given quantity of syrup will yield more sugar before than after subsidence. . . . . . It is a pity that so little use is made of the polariscope in British Guiana; that little instrument would quickly settle the comparative economies of different systems of manufacture. Neither the bottoms of clarifiers nor subsiders nor the scum from the copper wall should go to the distillery until they have been boiled and thoroughly subsided. . . . . The first strike of the pan should be boiled from syrup; on the pan striking half its contents, it can be filled with molasses reduced in density as little as possible and tempered. . . . . It is possible to obtain molasses sugar from the second molasses, but the quantity is so small, and the crystal is so poor, that in ordinary times it will not pay for the fuel necessary to reboil it, and will turn out a larger profit in the distillery. But whether molasses is sold without change, or reboiled in either way, it will always pay best to manufacture good sugar and molasses, which cannot be done without cleanliness and attention. It is well worth while to pay rather high for rapid transportation of sugar, which very quickly loses its bloom, and the sooner it is in the market, the better. . . . ."

The late F. W. Bolk.

An Appreciation.

On the 18th April, 1926, there passed away in Java F. W. Bolk, the eminent Dutch sugar engineer, and formerly Director of the Technical Department of the Experiment Station for the Java sugar industry.

Bolk, together with the late W. F. Maxwell, was an outstanding pioneer on the engineering side of the cane sugar industry. Born in 1875, he graduated as mechanical engineer at the Polytechnic, Delft, and after a brief sojourn in the Transvaal as a railway engineer, he left for Java to commence his career as a sugar engineer in 1903. His remarkable energy and ability were very soon appreciated, for two years later he was offered and accepted the position of Technical Adviser to the Experiment Station "Kagok," thereby becoming instrumental in creating its Technical Department. Thus began an era of great importance for the Java sugar industry, since from its embryonic stage this Department gradually developed, under Bolk's efficient guidance, into an institution of world-wide reputation.

At first Mr. Bolk was subordinate to the then Director of the Experiment Station, Dr. H. C. Prinsen Geerligs. But at the latter's retirement in 1908 the Institution was divided into two departments—Chemical and Technical. Mr. Bolk became Director of the latter, while Mr. J. J. Hazewinkel took over the former section. In 1922 Mr. Bolk resigned his position of Technical Director of the Experiment Station and became Technical Adviser to a group of factories under progressive management.

Only those who have had the privilege of coming into personal contact with Mr. Bolk can appreciate the extraordinary capacity for research work and the clear brain which he brought to bear upon all subjects with which he grappled. Paramount among his achievements are the excellent services he has rendered to the cane sugar world in establishing practical control of milling and fuel consumption. One duty of his office was to pay periodical visits to the sugar factories, whereby he acquired a wealthy store of information and experience. His advice on every aspect appertaining to sugar machinery was consequently highly valued.

Bolk was a great exponent of detail, but nevertheless had the knack of penetrating to the core of the problem and expounding it in a lucid manner. The Report he wrote after his visit to the Hawaiian Islands in 1911 on behalf of the Java Sugar Syndicate is in itself a masterpiece of thoroughness and completeness, and reveals to an uncommon degree the selective perception of detail with which this great engineer was endowed.

His numerous publications—both interesting and instructive—have from time to time appeared in the *Archief*. Unfortunately, Bolk's works have not been translated into the English language, and consequently his name may not be so widely known abroad; but it may be said that through his death, not only Java, but the cane sugar world at large, has lost one of its great pioneers and leading milling experts.

Francis Maxwell.

Mr. Edgar Garnett, who recently resigned an important administrative post in the West Indies, is now resident in England. He is prepared to give advice on cane sugar cultivation, manufacture, railroad and other transportation, accounting, marketing and general organization; also to investigate prospectuses and investments, and to visit and report on existing properties overseas. Mr. Garnett is a technologist of the first rank, and his name is a highly reputable one in sugar circles. There will doubtless be many desirous of consulting this gentleman in London, where he may be addressed at 57, Mortimer Street, W.1.

The Fulton-Farrel Double Crusher Lawsuit.

The Decision of the United States Court.

The action which has been pending for some months past in the United States District Court of Connecticut between the Fulton Ironworks Company of St. Louis and the Farrel Foundry & Machine Company of Ansonia, Conn., for alleged infringement of the former's Double Crusher patent,[1] was decided last month in favour of the defendants, and the action was dismissed with costs.

The Fulton patent described a pre-crushing means, consisting of two or more sets of toothed pre-crushing rolls, arranged to receive the cane in advance of the juice-expressing rolls. The teeth of the pre-crushing rolls are smaller than the teeth of the next preceding pre-crushing rolls, and the pre-crushing rolls nearest the juice-expressing rolls are therefore more closely assembled or associated than the other sets of rolls. The several sets of pre-crushing rolls are separated from each other a suitable distance, and on the cane passing through the second set a more complete crushing and shredding action takes place than that performed by the teeth of the primary set. The patent claimed as an original device that the sets of pre-crushing rolls operate in a differing degree on the cane to shred and open its cells, the teeth of the pre-crushing rolls nearest the juice-expressing rolls being arranged to effect a twisting action upon the cane as it passes through.

The defence of the defendants was that the patent was invalid because it was anticipated and therefore lacked invention in view of prior practices and patents; that it lacked originality, O'Neil (who filed the patent in dispute) having obtained his ideas from one Dardis; and that, finally, the Farrel machine did not infringe the plaintiff's patent because it did not embody those characteristics inserted in the specification and in the amended claims by the plaintiffs. As regards anticipation and lack of invention, it was proved to the satisfaction of the Court that it was an old and well-known practice many years prior to this patent to mount a pair of pre-crushing rolls provided with teeth in front of the juice-expressing rolls. The Krajewski patent of 1886 was cited in support of the contention; this well-known device provided a pair of crushing rolls (having teeth made in the rolls by short zigzag grooves) mounted in front of the three-roll mill with the object to cut or break only and not primarily to act as pressing devices. It was also proved to be a common practice many years before the application date of the Fulton patent to adjust the openings between the rolls of a cane mill, so that the opening between the rolls of each mill was smaller than the preceding one in the series; and also to set the rolls of a pre-crusher further apart than the rolls of the first set of juice-expressing rolls. The question then arose whether the addition of a further set of pre-crushing rolls amounted to invention or not. If two sets of pre-crushing rolls co-operated one with the other, each set modifying the action of the other set, it might be that inventive faculties had been called into action. But if each set of pre-crushing rolls worked independently of the other, each performing its well-known function without obtaining a new result, then the claims were unpatentable because they amounted to mere duplication. The plaintiff argued that it was not a case of mere duplication of what was old, but that by subjecting cane stalks to the successive treatments effected by the two pairs of wedge-shaped intermeshing pre-crushing rollers combined and operating in the manner cited, before the stalks passed through the mill rolls, great economy and efficiency was thereby obtained. The plaintiff also claimed that the two sets of pre-crushing rolls operated in a differentiating degree on the cane. But the Court found that this resulted solely from the fact that the rolls were set nearer in the second pair than they were in the first pair of pre-crushers—a common practice in cane mills prior to the applicant's invention. There was therefore no patentability in such a differentiating action, there being no co-operation between the two pairs of pre-crushers; each pre-crusher worked in the old and well-known way, so that the provision of two sets of pre-crushing rolls amounted in the view of the Court to nothing else but duplication.

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[1] Granted to J. F. O'Neil on January 14th, 1919; see *I.S.J.*, 1919, 471.

As for lack of originality, evidence was adduced to the effect that an old sugar man named DARDIS, who died in 1923, spoke to the Farrels as far back as 1913 advocating two sets of pre-crushing rolls; DARDIS was also shown to have communicated his ideas to O'NEIL, the patentee. The Court accordingly decided that the patentee was not the inventor of the improvements set forth.

Finally, it was proved that the Fulton roller action, to satisfy its claim, could only take place if the second set of rolls was revolving at a higher peripheral speed than the first set of rolls. In the defendant's device the reverse was the case. Secondly, the Fulton patent claimed to effect a twisting action upon the cane, but the specification was silent as to what produced this action, and no evidence was adduced in Court to show how it was caused. On the other hand, the defendant's machine did not claim to have any twisting action. Hence on both the above two points the claim to infringement was disallowed by the Court.

The Cane Sugar Industry in Natal.

Report of the South African Board of Trade.

The Report of the Board of Trade of the Union of South Africa on the Natal Sugar Industry gives a comprehensive summary of the present position, and is cast on the broadest lines. It is stated that the sole aim of the enquiry is the stabilization of the industry, and to save it from the past fluctuations between prosperity and depression, and with special respect to its legitimate market in South Africa; marked attention is drawn in the introductory historical chapter to the vicissitudes through which it has passed in its, at first, gradual and recent rapid rise to importance. The agreements between planters and millers are then discussed, and succeeding sections are devoted to plantation and factory work, which are separately treated. The internal finances of the industry are next dealt with, from the cost of producing the cane to the profits of the refineries, and the last section is devoted to exports and imports, marketing, duties, price-fixing proposals, and so forth. The report terminates with a series of conclusions arrived at, and recommendations suggested in all directions as to what are considered the immediate improvements called for.

We propose, in this article, to look back as far as the Sugar Enquiry Commission of 1922, which covered much the same ground as regards the internal organization of the industry, and comment on the changes which have taken place in Natal during these four years, as reported in these columns. To traverse the ground covered by the present Commission in its enquiries would inevitably entail a great deal of repetition, and we shall therefore content ourselves with appending the conclusions and recommendations as they stand. By this means it is hoped that our readers may best obtain a fair impression of the need for and meaning of this report, and the relative importance and urgency of some of the recommendations issued.

To some the present report may appear, at first sight, to be more or less a second edition of the earlier one, for, although many changes have taken place in the general outlook, in the main there is substantial agreement between the two. For one thing, the necessity for exporting some considerable part of the crop of sugar, forecasted in 1922, has now become a rather irritant fact; and it is therefore highly important, for the stability of the industry, that fresh stock should be seriously taken of the basis on which it is built up, to see how far it will be able to meet the actual world competition which has already commenced. Then, although there may not have been much change in actual procedure on the plantations or in the factories, the general view as to what should be done is in a very different stage from what it was then, in that the paths have now been pretty thoroughly explored, by which the desirable increase in the output and quality of sugar may best be obtained. Thus the Board of Trade is in a much better position to make suggestions than was possible four years ago; and it has become permissible for their recommendations to be couched in no uncertain language.

A fairly full summary was given of the report of the Sugar Enquiry Commission of 1922 in this journal.[1] Since the date of that summary the important innovation has been introduced of holding a series of Congresses year by year, at which all possible suggestions for the improvement (mainly of the plantation work) have been ventilated, with the definite aim in the background of diffusing the knowledge of up-to-date methods and bringing the whole planting industry into line, so that co-operation might be a realized force. It has been held before the delegates that such co-operation among the planters, as well as between planters and millers, was a fundamental necessity, as without it the prospect of raising the standard of efficiency was remote, if not altogether impossible. Concerted action is the only key which will unlock the puzzle in many biological as well as industrial problems. The published proceedings of these Congresses have added considerably to the sugar cane literature of the world, in that descriptions of local methods and environment in any country are important; and comparatively little was known before, outside Natal, of the actual conditions prevailing on the estates. It may help us to review the subjects discussed at these Congresses, and to indicate by marginal references where further information may be gathered concerning them in past numbers of this journal.

In the first Congress, held in 1923,[2] proposals were made for the foundation of an experimental farm: a number of papers were read on the actual practices on the estates, and the character of the Uba cane came in for a good deal of criticism. Sometimes a great deal of light is thrown on a subject by the discussion following a paper; and it is interesting to note how well the Uba cane came out of the ordeal by this means, chiefly perhaps because, with all its defects, it alone of the numerous other varieties dotted over the country in small patches showed immunity to the mosaic disease, with which careful inspection showed them to be riddled. Other subjects brought forward were cane by-products and their manurial value, the effect of humidity, fungi and bacteria on stored sugar, planters' practice in heavy land in Natal and on the alluvial flats of Zululand, prospective irrigation for Natal sugar growing, various pests in the cane fields, the use of statistics in the plantation work, and problems connected with labour. The net result of this extremely diverse series of papers was to show in how many respects intensive study was needed in the fields, once the matter was taken seriously in hand; and the Congress was regarded by everyone as a great success.

The Congress in 1924 covered a still wider field in its papers and discussions:[3] considerable progress had been made during the year, and various highly debatable questions had been threshed out so as to obtain a considerable degree of unanimity, especially with regard to the steps to be taken regarding the experimental station, the eradication of mosaic, and the necessity for the introduction of second string canes to take the place of Uba if that fine cane suffered from deterioration through some at present unknown cause. Milling difficulties with the Uba cane and the deterioration of its juice after cutting were discussed, and the importance of introducing labour saving devices in the mill yards pointed out: a series of short lectures on fundamental agricultural matters were delivered by experts of the Union, e.g., on the properties of the soil, soil fertility and its maintenance, the growth of plants, various pests and diseases of the sugar cane, while the whole question of manuring received a more detailed treatment. Agricultural costings were discussed scientifically, while labour difficulties were developed in three important papers by Government officials specially conversant with the native question. It is interesting to note in this Congress the whole-hearted way in which the Union experts, who of course had many other subjects besides sugar in their portfolios, threw in useful work, in order to give fresh impetus to the awakening desire of the industry to get out of its difficulties.

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[1] *I.S.J.*, 1922, pp. 456-461.

[2] *I.S.J.*, 1923, pp. 568-571.

[3] *I.S.J.*, 1924, pp. 574 and 577-580.

The latest Congress of which we have details was held in 1925,[1] and consisted mainly of planters. The proceedings were limited to three days' work and, to increase the interest of the meeting, each day was spent in a different section of the cane belt. Unfortunately heavy rain not only prevented many planters from attending, but limited the out-of-door demonstrations which had been planned. As in each of the previous years, some details were given of the progress of the work on cane disease which had been going on from the start: a list of the chief cane pests was given and remarked on, and the most suitable varieties of cane for introduction into Natal were discussed. Cane harvesters and loaders were described, and again various labour questions occupied the attention of the Congress: the purchase of fertilizers received a good deal of attention, together with the best methods of their application: the scientific basis of green manuring was formulated, and its application to sugar cane cultivation in Natal elaborated: irrigation for sugar cane estates was dealt with, and a thoughtful paper on animal transport on sugar estates formed an important contribution to plantation work. This latter paper was selected for analysis in our reference to the Congress.

These details will give some idea of the stages through which the industry was passing. After a period of rapid extension and settled complacency, a feeling of insecurity arose as to the future; and a new spirit of enquiry was set going, with the result that it was found that all was not well. The sugar industry in Natal is built up of a number of different interests, and some of these are more or less antagonistic; one result of the four years' study is that it is increasingly felt that, for the industry to be placed on a firm basis, a great deal more co-operation between these different interests will be imperative. The leaders in the Congress have from time to time strongly adverted to this matter, but the Board of Trade finds it still necessary to draw attention to the lack of unity, and one of the objects of its recommendations is obviously to remove what causes of friction still exist. In no case, perhaps, is the parable of the house divided against itself more applicable than to any industrial concern at the present time.

Meanwhile, a great deal of work was being quietly carried through among cane diseases in the field, the most important at the moment being mosaic, which had been discovered in Natal, and the new variant, streak, to which the resistant Uba cane was found subject. It has been our aim to keep our readers fully informed of the different stages in this important work, which is by no means yet completed, and is of universal importance.[1] It must be remembered that no appliances were to be found in Natal for such work at the start, and when these were to some extent available, at once the need of an experiment station and proper quarantine building was felt. All of these have, we believe, been now supplied. But, for the mosaic fight to be effective, it was considered necessary to destroy all canes suffering from it; and, as Uba was the only resistant form in Natal and occupied all but an insignificant fraction of the cane fields, the question resolved itself into destroying all other canes but Uba. That question had to be threshed out and appropriate means found for the prevention of any hardship. It was felt that it was of little use introducing fresh cane varieties into Natal, while mosaic was still present. Equally lengthy discussions were maintained about the experiment station, but there were no vested interests here, and agreement was more easily attained. In the nature of the case, it will take several years before the station will be able to turn out much useful work. If we are not very much mistaken, this is but the beginning of a much extended system of experimental work, which will include many estates in different parts of the cane belt, and certain sub-stations for special localities or subjects. But, if well founded, the beginning of experimental work is everything.

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[1] *I.S.J.*, 1925, pp. 580-584.

Little has been said about the factory side of the industry, and that is, presumably, because this branch of the industry is in a much more advanced condition. At any rate this seems to be the general opinion; the Board we notice has certain improvements to suggest even here. A long paper by MAXWELL[2] on the carbonation process for dealing with the refractory Uba juice, and a short one by CAMPBELL[3] on the satisfactory introduction of this process into Mount Edgecumbe in Natal should be consulted, as the Board appears to be of opinion that it should replace that at present in use. In spite of the greater cost of carbonation, it will probably be more profitable in the long run and, more important still, will give uniformity to the product, and thus directly influence and simplify the whole complicated system of payments for cane.

The following are the conditions and recommendations of the Board of Trade:

The Board believes that the Sugar Industry is not being conducted on sound economic lines. The proposals now put forward as the result of the Board's Inquiry are designed to stabilize the Industry. The first essential to progress in this direction is the promotion of a spirit of co-operation between the various interests in the Industry in order to secure united action to improve its organization. With that end in view the Board presents the following recommendations and comments to Government and the Industry in the order in which the matters referred to are dealt with in their report:—

(1) At the outset of the Inquiry it was obvious that the 1905 Miller-Planter Agreements were not in keeping with the present development of the Sugar Industry. The Board accordingly recommends their immediate revision on the lines suggested in Chapter VI.

(2) The Board is of opinion that Government should evince more interest in the research and field work of the Industry, and recommends the establishment of a small bureau of pathology and entomology to co-operate in this direction.

(3) It is recommended that the burning of cane be discouraged as far as possible; that for a period of five years a higher price should be paid for hand-trashed cane than burnt cane, and that thereafter the burning of cane should be illegal.

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[1] *I.S.J.*, 1923, p. 570; 1924, pp. 583, 578, 579; 1925, 458, 472-479, and 1926, pp. 300-302.

[2] *I.S.J.*, 1923, pp. 572, 624.

[3] *I.S.J.*, 1925, p. 556.

(4) The Board found that planters are not indifferent to the value of fertilizers; there is, however, urgent necessity for the general adoption of a system of rotation in order to allow severely-cropped land to lie fallow. Little evidence of excessive ratooning was forthcoming.

(5) The planters, particularly in Zululand, are working under heavy labour difficulties, mainly owing to the prevalence of desertion, and recruiting of physically unfit natives. The Board recommends that Government take into consideration the advisability of amending the Pass Laws to provide for the recording of contracts, the issue of a standard pass form, and the establishment of a central registration office. Further, that Act 15 of 1911 be so amended as to place upon recruiting agents the onus of certifying that natives engaged under contract are free from serious diseases.

(6) The Board is of opinion that much can be done to improve the transportation facilities of the planting industry. There is room for better regulation of Railway truck supply, and it is especially recommended that the Railway Administration should devote careful attention to the feasibility of providing special trucks for the carriage of cane.

(7) The lack of co-operation in experimental work is a regrettable shortcoming of the South African Sugar Industry. The Board recommends that serious consideration be given to the suggestion that qualified chemists should be appointed to carry on work for the industry as a whole.

(8) In the interests of milling efficiency a firmer attitude is desirable in regard to the crushing of inferior or dirty cane. Every effort should be made to secure co-operation between miller and planter in obviating transportation and other delays in carrying cane from the fields to the mills.

(9) A shorter crushing season would obviously be beneficial to planters and millers. This would afford the former more time for cultivation, and increase mill recovery results.

(10) The Board finds a need for closer correlation of cane supply and milling capacity. Under or excessive estimates of available cane are too common, and the practice of leaving cane standing in one area at the end of the season which might have been milled in another district is to be deprecated. It is recommended that endeavours be made to secure accurate crop estimates with a view to the allocation of surpluses to such mills as are in a position to take outside cane.

(11) The Board commends to the milling industry the advisability of establishing a system of standardization of product that will reduce the diversity in grades of the sugars now produced.

(12) The Board supports the principle of a central refinery. In view of the existence of the valuable carbonation process and the setting up of the Suchar process in the Industry, in addition to a large refinery, the central principle might be extended to cover all three. The chief desideratum is to eliminate inferior mill whites from the market.

(13) The labour and employment aspects of the milling industry call for attention from the national standpoint. The Board is in agreement with influential sugar opinion that a considerable number of apprentices could now be absorbed in the mills. To further this end the Board recommends that an industrial council or joint board should be constituted, including representatives of employers and employees, with the addition of an outside chairman (preferably an educationist). Organization of mill employees in a general body would greatly facilitate the carrying out of this proposal.

(14) As set out in Chapter VII, the Board strongly recommends the framing of standard scales of payment for cane, particularly the substitution of sucrose content for the cane weight basis.

(15) The need for the installation of accurate milling cost systems must be emphasized. It is felt that expenditure can be cut down, and it would appear that costs of production are now unduly increased by excessive depreciation and maintenance charges.

(16) The Board is of opinion that unless the Industry achieves increased efficiency and improved general organization, it will be difficult for millers to pay more for cane. Under existing conditions of production and marketing it would appear to be difficult for most mills to pay higher prices for cane.

(17) Radical changes in the distribution of sugar appear to be necessary. This service should not be involved with extraneous business transactions. The combining of agency activities with sugar trading has been an undesirable feature of distribution in the past. The Board recommends a departure from the old methods and the substitution of a combined central warehouse and sugar exchange as a buying centre.

(18) The Board feels that the South African Industry is in particular entitled to protection against unfair competition from Mozambique, and considers that the carriage of sugar from the territory at South African Produce rates on the Union Railways is an anomaly that should not be perpetuated.

(19) The Board holds that the industry should have the full benefit of the South African market, provided that the consumer is safeguarded against exploitation. Therefore, it is recommended that item 43 of the Customs Tariff be amended to read:—

43.—Sugar and Sugar Substitutes :—

	Min. Duty. £ s. d.		Max Duty. £ s. d.	
(a) Candy, loaf, castor, icing and cube sugar, per 100 lb...	0 6 0	..	0 6 0	plus a suspended duty of 3/6.
(b) Other kinds of sugar, including golden and maple syrup, molasses, glucose and treacle per 100 lb.	0 4 6	..	0 4 6	plus a suspended duty of 3/6.
(c) Saccharine and other similar sweetening substances, and materials capable of conversion into such substances, per lb.	1 0 0	..	1 0 0	

It is further recommended that, upon the Government's acceptance of satisfactory assurances that the Sugar Industry is prepared to comply with the conditions set out on pp. 78-79 of this Report, the proposed suspended duties should be made effective.

Finally, the Board is unable to support, under prevailing conditions, any proposal involving the employment of public funds for the purpose of establishing a Beet Sugar Industry in the Union.

Mr. R. G. W. **Farnell** has resigned his post as Chemist of the British Empire Sugar Research Association, London.

Referring to some particulars published regarding the Mercedita Suchar Refinery, Ponce, P. R.,[1] 900 (not 500) sq. ft. filtering area are in use. In addition there are two "Windok" electric revivifying furnaces, having a daily capacity of 4·0 short tons of carbon daily.

[1] *I.S.J.*, 1926, 216.

Has the "Double Crusher" Reason for Existence?

By FRANCIS MAXWELL, D.Sc., M.I.Mech.E., F.C.S.

The Fulton-Farrel case is ended. The Court has decided in favour of the Farrel Foundry & Machine Co., as has been generally anticipated from the very outset. What with this widely advertised lawsuit in America and big headlines of "Smashing Records" appearing elsewhere, the "Double Crusher" has come into some prominence of late. It would therefore not be inopportune, perhaps, to inquire into the subject of "Double Crushers" from another aspect—one of more concern to the sugar manufacturer.

Although this subject has from time to time found its way into print, it rarely reflects the unbiassed opinion prevailing among milling experts, and it is rather by word of mouth that its controversial nature reveals itself to an unsuspected degree. This was evident from discussions the writer had the privilege of enjoying with officials of Experiment Stations as well as technical advisers and mill engineers during his recent tour of various leading sugar cane countries. It is, indeed, partly based upon the outcome of these conversations, supplemented by results of first-hand investigations on the spot, that this article is written. The writer, however, hastens to add that although opinions expressed by well-known milling experts are necessarily embodied within these pages, he alone is responsible for all that appears therein which is not expressly attributed to others.

What, to begin with, are the grounds that justify one to question the *raison d'être* of the "Double Crusher?" In face of the fact that quite a number of these plants are in actual operation—though chiefly confined to certain regions—the above title may, at first sight, strike the reader as somewhat sweeping. Nevertheless, the writer ventures to submit that the following exposition will prove its justification.

For some time recently the possible merits of the Double Crusher has formed the subject of keen interest and investigation in Java, and the opinions of various leading experts have been expressed at several consecutive meetings held by the "Association of Technical Experts to the Java Sugar Industry" and recorded in the *Archief.*[1] Instructive data relating to a double crusher have been compiled by MOOYAART,[2] to which reference should be made. The general opinion of the experts is reflected by the conclusion submitted to the meeting by NOBEL,[3] Chief of the Technical Department of the Java Experiment Station, and endorsed by BOLK, the former Chief, among others, viz., that so far as Java is concerned, no benefit is derived from adopting the Double Crusher. To-day there are only two "Double Crushers" in the 180 odd factories in Java.

Let us now transfer our attention to the Hawaiian Islands, which, as is generally acknowledged, lead the world in respect to milling. This commendable status has been achieved without the aid of a single "Double Crusher."

The reasons for primarily adducing these two countries are twofold: first, because, as a whole, they rank highest among sugar cane countries in respect to both the extraction of sugar and scientific control; and second, because their official statistics are the most thorough and complete. It may be added that the data referred to hereafter have been obtained from official reports issued by the Sugar Experiment Stations of the respective countries. Here are some figures which, to the writer's knowledge, have not appeared before in their present striking form:—

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[1] *Verslagen*, 1923, 1924, 1925. [2] *Verslagen*, 1924, p. 43. [3] *Verslagen*, 1924, p. 46.

Preparation Plant.	Hawaiian Islands.[1]	Java.[2]
Single crushers	30	105
Three-roller crushers	7	—
Double crushers	none	2
Shredders	13	10

Furthermore, in Queensland, where likewise high figures of extraction are met with, all factories are equipped with shredders instead of crushers, and therefore the Double Crusher does not even come into consideration. Again, in the Philippine Islands,[3] where Hawaiian practice is taken as the model, no use for the "Double Crusher" has been found. Mauritius, Egypt, and other countries may be further adduced, but let this list suffice.

Such are the cogent facts that must needs render anyone conversant with milling practice sceptical as to the utility of the "Double Crusher," and sufficiently justify the writer in taking the bold step of submitting the question embraced by the title of this article.

Having thus established a broad basis for our discussion, i.e., that the best milling results are being achieved without the aid of the "Double Crusher," it is proposed to develop our argument under three main headings: (*a*) Preparation, (*b*) Extraction, (*c*) Capacity.

PREPARATION.

The crusher, as originally conceived and since universally accepted, is essentially a cane preparatory device. Since the "Double Crusher" is merely a duplication of the crusher unit, its function implies the enhancement of the result produced by one crusher. Accordingly, the "Double Crusher" is supposed to be—indeed claimed and advertised to be—a cane preparatory plant "par excellence." Now the purpose of a cane preparatory plant is to prepare the cane for subsequent milling with a view to enhancing the aggregate extraction of juice (sugar). What are the facts about the "Double Crusher" as a cane preparator? For those readers who have not had the opportunity of seeing a "Double Crusher" in operation, a few illustrations are appended in order that they may form their own opinion as to the quality of work obtained by this class of cane preparators.

Photographs I and II represent actual results of two different makes of Double Crushers, each claimed to be the best of its kind.[4]

To be fair, it must be stated that the cane crushed in both cases was "Uba," a variety notorious for its hardness as well as high fibre content. But, on the other hand, it is from South Africa[5] that recently a hubbub of phenomenal performances has been heard. It is, moreover, evident that where the cane is soft and of low fibre content, the duplication, and still more so, the triplication of crushers for preparative purposes, would be mere extravagance. This, incidentally, may be one of several sound reasons why the "Double Crusher" is deemed superfluous in countries like Hawaii, Java, Mauritius, Philippine Islands, Queensland, etc.[6] Hence, if the "Double Crusher" is ever to justify its reason for existence as to the preparation of the cane, it should be in Natal and Zululand, to be sure, where it is offered an ideal opportunity. Does the nature of the "prepared" cane as shown in the above cited photographs give reason for hope? The mill engineer will judge for himself.

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[1] *Annual Synopsis of Mill Data*, 1924, H.S.P.A. Experiment Station.

[2] *Archief Jaargang*, 1925, No. 10, Report Experiment Station.

[3] *Annual Synopsis of Mill Data*, 1924, P.S.A.

[4] Several representing other countries are not published here owing to want of space.

[5] In this country the Uba cane is almost exclusively grown.

[6] Cuba, where the cane has a low fibre content, is deliberately excluded here as it will be separately dealt with under the heading "Capacity."

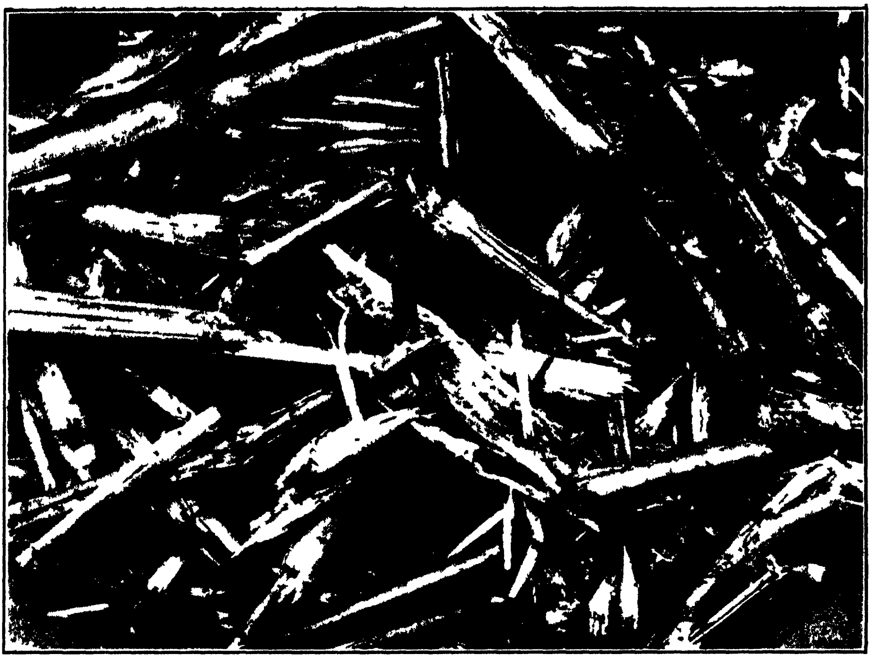

Fig I

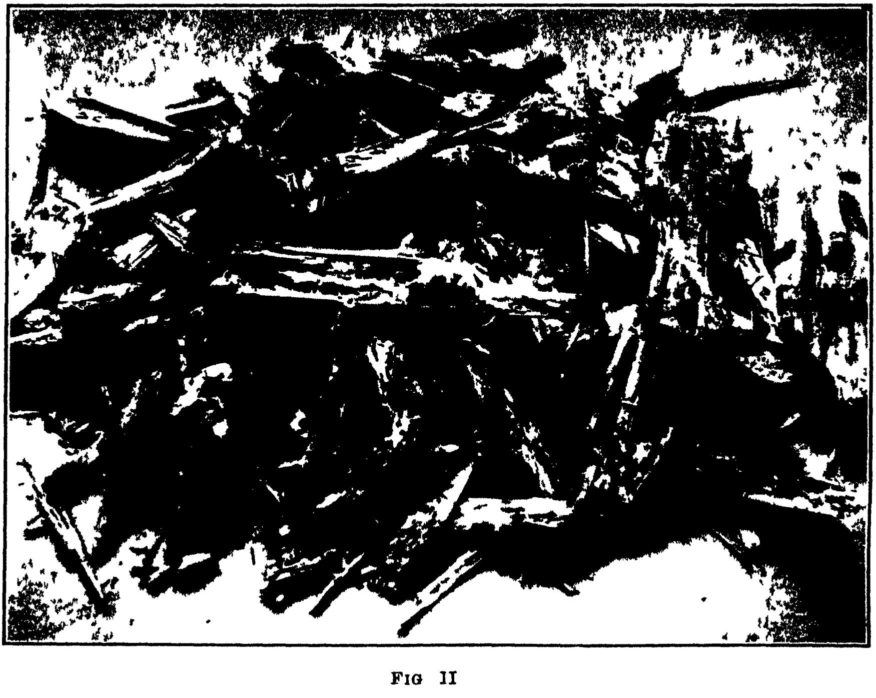

Fig II

All Photographs appearing in this Article have been reduced to same scale and are therefore directly comparable

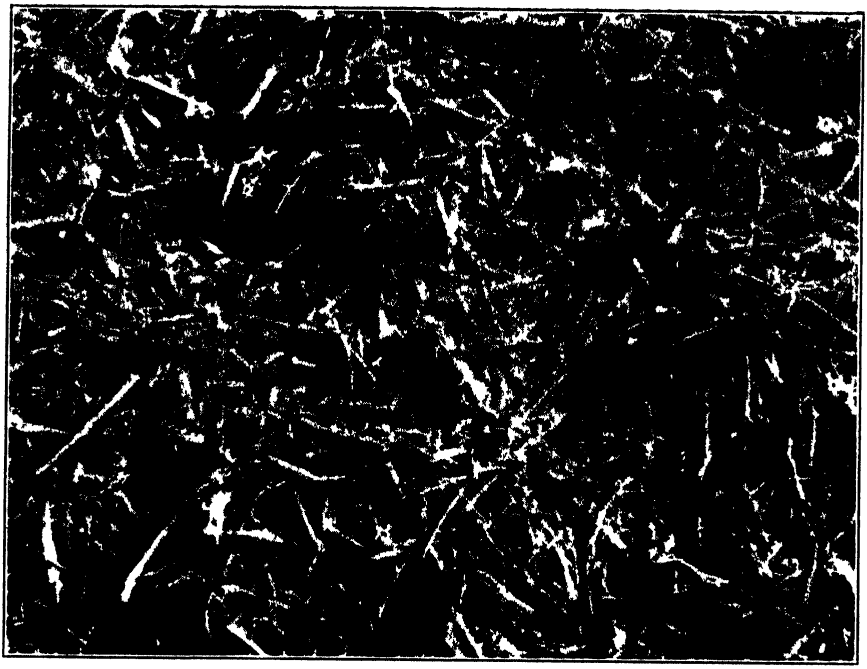

FIG. III

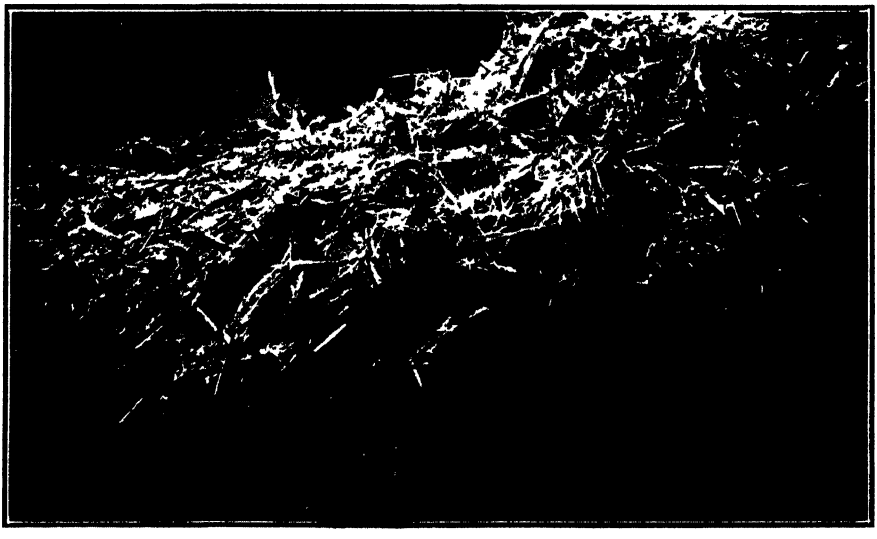

FIG. IV

All Photographs appearing in this Article have been reduced to same scale and are therefore directly comparable

It should be borne in mind that the crushed cane, in the state as shown coming from the Double Crusher (Figs. I and II) is now to enter the first of a train of mills. The duty of cane mills, as generally granted, is—or should be—purely and simply the "expression of juice"; the preparation of the cane being the task of the preceding cane preparatory plant, whatever that may be. It stands to reason that the first mill following the "Double Crusher" in the cases illustrated by the photographs must needs act as an additional preparator, and consequently will have to sacrifice to a greater or less extent its true duty of simply expressing juice.

It is necessary—for the sake of clearness—that we digress here a little in order to provide the reader with an optical comparison. The photographs (Figs. III and IV) show the results of a different class of cane preparatory devices, namely that of the modern shredding type.

To revert to our point, is it not evident from these photos that the first mill of a train receiving such thoroughly prepared material is called to perform no other duty than that which it is designed for, to wit, the expression of juice?

The mills can only work at highest efficiency when the cane has reached a state approaching those shown in Figs. III and IV. In plants including a modern shredding device this is reached at once *before* the first mill, while in plants with single or double crusher, it is not reached until *after* the first or even second mill. It may be useful for consideration to divide the plant into preparative and true milling sections, thus:—

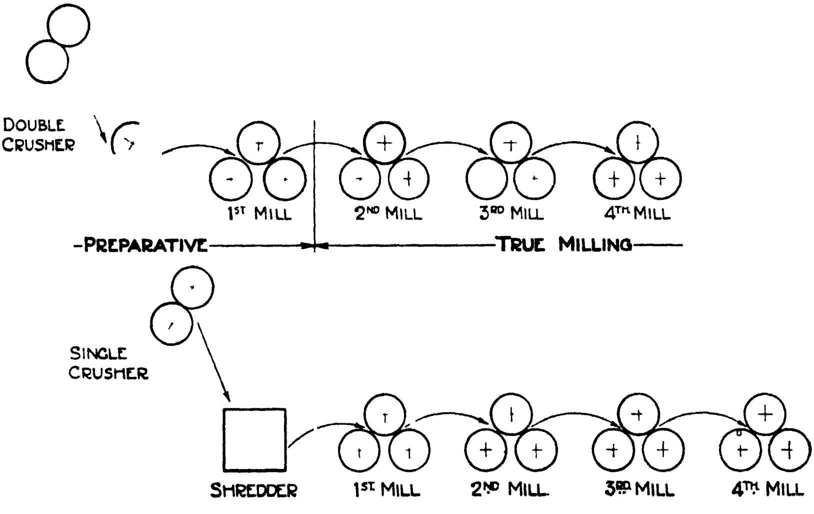

Fig. V.

This is not the place to enter into a discussion of other types of cane preparatory plants with a view to showing their superiority—both as to efficiency and economy—over the "Double Crusher," but in order to afford some basis for comparison as to preparative efficiency it has been necessary to allude to cane preparators of the modern shredding type. From the comparison of the above illustrations it would appear that it is towards the thorough shredding of the pre-crushed cane rather than the multiplication of crusher units that one has to look for the most efficient and economic method of extracting juice. But apart from shredding plants altogether, a comparison between the results of the "Three-roller Crusher" and the "Double Crusher" in regard to preparative efficiency, will readily prove the futility of two separate units of two rollers each instead of one unit consisting of three rollers. The result shown in the photograph Fig. VI is that of a first mill (without any preceding preparatory units) provided with a toothed roller as top roller, crushing hard cane (B. No. 247 Java) of about 15 per cent. fibre. The so-called "Three-roller Crusher" will be fuller dealt with under the next heading "Extraction."

Summary. The above discussion leads to the first conclusion, i.e., that so far as the preparation of cane is concerned, the Double Crusher does not appear to have a reason for existence.

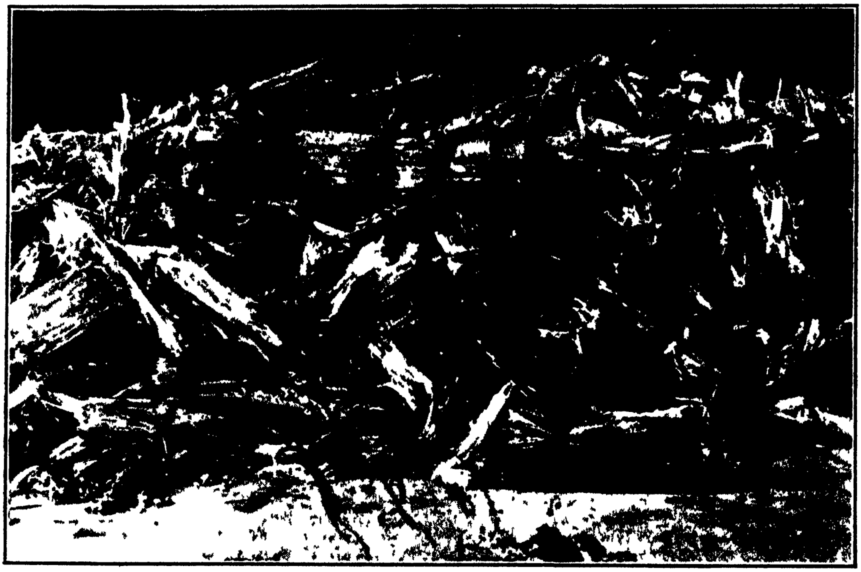

FIG. VI

EXTRACTION.

Apart altogether from the preparation of the cane the "Double Crusher" of course extracts a certain amount of juice; and since this fact is often magnified as another merit of this plant, it is necessary to consider this point of view as well. In this connexion, however, it must be remembered that the process of expressing the juice from the cane is the prerogative of the mill and not of the preparatory plant, whose essential duty—as its name clearly signifies—is the preparation of the cane.

Misleading statements in regard to "increased extractions" have been of frequent occurrence, and it may perhaps be well to dwell on this subject a little. Does it not stand to reason that it is primarily the quality of the preparation of the cane rather than the quantity of juice expressed by the cane preparators which governs the aggregate extraction of the milling plant? In other words, if the train consists of preparatory units (whatever they be) plus, say, four mills (see Fig. V) and owing to inadequate treatment of the cane the first mill has to act as an additional cane preparator, it is plain that the purely extractive part of the plant is reduced to three mills. On the other hand, if the cane preparatory installation be efficient, four mills would be available to express the juice. Moreover, the process of maceration is a most important factor, and its efficiency is naturally more readily assured when there are four instead of three mills available for purely extractive purposes.

Given a milling plant of a reasonable number of units, and an extra preparatory unit—or units—is added thereto, it is obvious that the aggregate extraction will thereby be increased, provided the limit has not been reached already. To be more concrete, suppose the original milling plant consist of four mills only, and a "Double Crusher" be subsequently placed before them, is there anything phenomenal that a considerable "increase of extraction" is thereby experienced? The question is: Need one go to such a considerable expense, initial capital outlay, maintenance, etc.—to obtain the same result? If the same—or even better results—can be obtained for less cost, it is clear that the "Double Crusher" is superfluous.

It is not proposed in this article to adduce cane preparatory devices of the shredding type in support of our argument, but rather to confine ourselves to kindred plants.

The "Three-roller Crusher," already mentioned elsewhere, has recently come to the fore in the Hawaiian Islands, and is doing excellent work. It is, in fact, a mill of which the three rollers are provided with steep annular grooves, and so arranged as to intermesh with one another. We can do no better than to quote McAllep in the "Annual Synopsis of Mill Data, 1924"[1]:—

> "The fact that three of the first nine mills in Table 4 are three-roller crushers and nine-roller mills, while one is in second place, draws attention to the efficient work secured from modern three-roller crushers. An extraction of 75 per cent. of the total juice is not particularly high for a three-roller crusher working under reasonably favourable conditions, while securing 50 per cent. of the total juice is excellent work with two-roller equipment. . . . . . There is little doubt that comparisons of two and three-roller crushers, taking into consideration fixed charges, operating expenses and the results secured, are considerably in favour of the three-roller type."

We have seen it claimed that "Double Crushers" extract about 65 per cent. of the total juice.[2] It will be observed that this is lower than the figure stated in the above quotation for a single three-roller crusher. That is to say, if one uses a Double Crusher, one pays for and operates four rollers, gaining thereby no more juice than if three rollers were used. So far, then, as extractive power is concerned, it will always pay rather to add mills than to add crushers.

As to aggregate milling results, which after all is the ultimate aim, it may be of interest to give the following figures showing the average extraction for all factories in the Hawaiian Islands appearing in the Synopsis of Mill Data:—

Year.		Extraction.
1922	......	96·89
1923	......	97·24
1924	......	97·37

As already mentioned at the beginning of this article, these collective extraction records are all obtained without the use of a single "Double Crusher."

Summary. We may, therefore, safely conclude that so far as "Extraction" is concerned, there should be no reason of existence for the "Double Crusher."

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[1] Published by the Experiment Station of the H. S. P. A.

[2] *I.S.J.*, 1921, p. 281.

CAPACITY.

Under this heading lies the crux of the question as popularly conceived. Cuba, as we know, constitutes the stronghold of the "Double Crusher." Considering that the average cane grown on this island is of the soft variety with a low fibre content, it would appear rather superfluous that a number of factories should resort to doubling or even trebling the Crusher unit. What then is the reason for the apparent paradox? The reply is to be found in the fact that Cuba implies Capacity. The production of cane in Cuba has, as is known, increased very rapidly and by leaps and bounds, especially during the last decade. At first the expansion of cane production appears not to be adequately met by simultaneous expansion of the milling plant.

As the annual crops became greater, factories first resorted to speeding-up the existing mill plant, then to lengthening the train of mills in one line rather than in parallel sets. With the primary object of coping with the ever-increasing crops, the idea of multiplying the crusher unit to "Double Crushers" and even "Triple Crushers" gradually struck root in Cuba. But does it necessarily follow that it was and is the only and most economical way to set about coping with exceptional capacities? The writer does not think so, and submits the following facts and figures in support of his opinion.

To begin with, as DEERR[1] puts it:

> "Capacity and not extraction is the object of the Cuban mill. Whereas Hawaiian practice regards the milling plant as a means of extracting sugar, that of Cuba looks upon it as a means of grinding cane."

Taking for granted that capacity is the *sine quâ non* in Cuba, we are asked to believe that "Records in capacity" invariably go hand-in-hand with "Double Crusher" equipments. In this connexion we may adduce the following data of the Central Consuelo, Santa Domingo:—

Average Figures for an entire Season.

	Tons.
Cane crushed in 206 grinding days	624,603
,, ,, per hour (during six hours)	155
,, ,, ,, (during cleaning day)	100
,, ,, per average hour of work	141·3
,, ,, per grinding day	3,400
	Per cent
Sucrose, per cent.	10·52
Fibre, ,,	10·45
Saturation, ,,	12·59
Extraction, ,,	93·19

The above figure of tonnage crushed by the milling plant is unquestionably high, and indeed, until quite recently, was claimed by the factory in question to be the "world's record."

It is to be noted particularly that this result was obtained by a milling plant consisting of one *single* crusher and six mills of 36 in. × 84 in. size.

Again, Central Vertientes[2] in Cuba now claims the world's record in capacity by crushing over 5600 tons per 24 hours. As in the previous case this has been achieved by one *single* crusher, but followed by seven mills of 36 in. × 84 in.

If a *single* crusher can cope adequately with such exceptional capacities, where is the sense of resorting to a *double* crusher, with all its attendant extra costs?

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[1] *I.S.J.*, 1920, page 216.

[2] *Facts about Sugar*, 1926, No. 22.

Surely these cases suffice to dispose of the idea that a "Double Crusher" is indispensable for large capacities.

Summary.—Hence even where capacity is the prime factor, the "Double Crusher" is not found to be an indispensable entity.

CONCLUSION.

In view of the existence of cane preparatory plants which are at once more efficient, more economical, and, last but not least, less expensive, the above arguments, based on authoritative facts, lead to the conclusion that the "Double Crusher" has no reason for existence.

Manufacturing Results from certain Natal Sugar Factories for 1925-26 Season.[1]

No. of Factory	Sucrose in Cane (per cent.)	Sucrose in Crusher (C) or 1st Mill Juice (M) (per cent.)	Sucrose in Cane, divided Sucrose in Crusher or 1st Mill Juice ×100	Fibre in Cane (per cent.)	Sucrose in Juice, per cent. Sucrose in Cane.	Dilution, per cent. of normal Juice.	Purity of Mixed Juice, apparent (A) Clerget (C)	Sucrose in Bagasse (per cent)
1	13.240	17.17(M)	77.2	14.88	91.82	29.23	85.01(C)	3.37
2	12.867	16.87(C)	76.3	—	85.75	—	86.7(C)*	4.69
3	12.851	17.00(C)	75.6	16.31	86.50	15.88	84.1(A)	4.883
4	14.840	17.06(M)	75 3	14 99	86.12	—	86.13(A)*	5.16
5	12.740	16.44(C)	77.4	15.18	86.11	—	86.07(C)*	4.40
6	12.650	16.41(M)	77.1	14.67	91 65	16 80	84.1(C)	3.37
7	12.640	16.65(M)	76 0	16.15	87.37	20.56	84.8(A)	4.50
8	12.510	17.01(M)	73 5	15.89	89.30	30.16	85.2(C) 83.9(A)	3.83
9	12.390	16.72(M)	74.1	17 75	89.23	25.81	80.97(A)	3.52
10	10.620	14.57(M)	73.0	17.81	88 78	18.58	80.70(A)	3.06

* Clarified Juice.

No. of Factory	Moisture in Bagasse per cent.	Sucrose in commercial product per cent. Sucrose in Juice.	Yield, tons Cane per ton of Sugar.	Sucrose per cent Cane lost in manufacture.	Sucrose lost in mfre. per cent. Sucrose in Cane.	Sucrose in commercial product per cent. Sucrose in Cane.	Purity of Final Molasses, apparent (A) or Clerget (C).
1	49.51	86.18	9.52	2.760	20.87	79.13	40 97(A)42.50(C)
2	50.70	84.00	10.73	3.599	27.97	72.03	46.6(C)
3	47.81	80 35	11.19	3.919	30.50	69.50	48.3(A)
4	49.87	80.60	11.09	3.920	30 56	69.44	46.47(A)
5	48.36	84.78	10.64	3.440	26 99	73.01	42.41(A)47.96(C)
6	48.86	81.05	10.45	3.250	25.69	74.31	46 2(A)50.7(C)
7	48.64	84.71	10.61	3.280	25 99	74.01	40.9(A)
8	49.76	79.42	11.22	3.640	29.08	70.92	44.5(A)47.9(C)
8	47.13	78.59	11.48	3.700	29 87	70.13	40 54(A)
10	49.72	83.80	12.43	2 720	25.59	74.41	39.6(A)

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[1] This is the first mutual control tabulation of the results of sugar factories in Natal. It was compiled by a sub-committee of the South African Sugar Technologists' Association See *S.A. Sugar J.* 1926, 10, No. 4, 259.

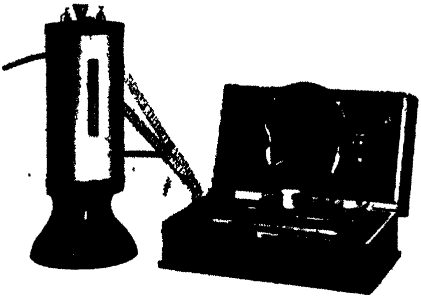
Electrical Conductivity Method of determining the Ash Content of Raw Cane Sugars.[1]

By F. W. ZERBAN and JOHN MULL.
New York Sugar Trade Laboratory.

Some time after Arrhenius' fundamental investigations on the electrical conductivity of salt solutions containing non-electrolytes, the conductivity of sugar products and its relation to their ash content was studied in Europe by MAIN[2], by TRENKLER[3], and more extensively by LANGE[4]. Then the subject rested for a number of years, and interest in it has only lately been revived by the work of SNELL[5] on maple products, by LUNDEN[6] and by TÖDT[7] on beet products.

TÖDT'S APPARATUS.

The last-named author has designed a very convenient apparatus which consists of a ruggedly built conductivity cell of proper capacity, with water jacket and thermometer, and a measuring outfit calibrated directly in per cent. of ash. An ordinary dry cell furnishes the preliminary current, which is converted into alternating current by a small inductorium. These two parts, together with the balancing resistance, the Wheatstone bridge, and the telephone, are all enclosed in one box, so that it is only necessary to connect the conductivity cell with the measuring apparatus by a pair of wires to be ready for a determination. The bridge is provided with five scales which partly overlap and cover altogether the entire range of ash percentages up to three per cent. The scales are calibrated on the basis of the experimental data of LANGE,[4] who measured the electrical conductivity of solutions of several hundred German beet sugars in which the ash had previously been determined by the chemical method. He used solutions of 5 grms. sugar in 100 c.c., and the calibration of TÖDT's apparatus is based on the same concentration. A correction is applied for the conductivity of the distilled water used, and if necessary one for temperature, also. For syrups, molasses, etc., in which both ash and sugar content are naturally different from those in raw sugars, further simple corrections must be introduced. It takes only a few minutes to complete a determination.



TÖDT'S Electrical Ash Apparatus.

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[1] Condensed from *Facts about Sugar*, 1926, No. 12, 21, 278.

[2] *I.S.J.*, 1909, 11, 334. [3] *Oesterr-Ung. Zeitsch Zuckerind*, 1910, 39, 423; *I.S.J.*, 1911, 50.

[4] *Zeitsch Ver. deut. Zuckerind*, 1910, 60, 359; *I.S.J.*, 1910, 423. [5] J.A.O.A.C., 1921, 4, 435.

[6] *Cent. Zuckerind.*, 1925, 33, 204; *Zeitsch Ver. deut. Zuckerind*, 1925, 75, 763; *I.S.J.*, 1925, 671.

[7] *Zeitsch Ver. deut. Zuckerind*, 1925, 75, 429; *I.S.J.*, 1925, 503; 1926, 136.

APPLICABILITY TO CANE SUGARS.

It is a well known fact that the composition of the ash of cane products is not the same as for beet products, and it might therefore be expected *a priori* that the conductivity would be different also. However, the results, which are given in detail below, were encouraging. The results of the conductivity method indicate the mineral constituents in the water soluble part alone. This, however, is rather an advantage. Both the raw sugar manufacturer and the refiner are interested more in the soluble ash, which affects the recovery of sucrose, than in the soluble ash. In many cases the insoluble ash is within the limits of error of the chemical method.

A more serious problem is presented by the old question whether or not the so-called carbonated ash, obtained by direct incineration, represents a true measure of the mineral constituents, and what relation the sulphated ash bears to the incinerated ash as well as to the true mineral content.

BROWNE and GAMBLE[1] have shown that in the direct incineration of sugar products there occurs a substantial, but variable, volatilization of chlorine, depending largely on the relative quantity of alkaline carbonates formed in the process of ashing. Sulphur is also lost by volatilization. The fact that the deduction to be applied for converting sulphated ash to carbonated ash is only about 10 per cent. for beet products, while it is nearer 20 per cent. for cane products, is probably largely due to different proportions of chlorine and sulphur lost by volatilization in ashing the two classes of materials. It is evident that incineration after addition of sulphuric acid should give a truer indication of the quantity of mineral matter present than direct incineration, because in the former case the salts of volatile acids are completely converted into sulphates, and the total quantity of fixed bases is weighed in that form. It is then simply a matter of agreement whether or not a correction factor should be applied to the sulphated ash, as has been done in the past; the relative results will not be affected by such a correction. The Association of Official Agricultural Chemists has decided to report "sulphated ash" as such, without any deduction. But in the methods of the International Commission for Uniform Methods of Sugar Analyses the ten per cent. correction is still maintained.

METHODS USED IN TESTS.

Both LANGE and TÖDT base their comparisons between ash and electrical conductivity on the ash obtained after incineration with sulphuric acid, deducting one-tenth from the result. The scale of TÖDT'S apparatus is likewise calibrated according to this procedure. In view of these facts, and also for the reasons given above, our ash determinations in the raw sugar samples examined by us were made in three different ways as follows:—

(1) Total sulphated ash, according to the official method of the A.O.A.C.,[2] but deducting one-tenth from the result obtained.

(2) Sulphated ash in water-soluble part of the raw sugar. Twenty grms. of the sugar were dissolved in water to a total volume of 100 c.c., 50 c.c. of this unfiltered solution being used for the conductivity determination described under (3). The remainder was filtered through an asbestos mat; as soon as enough filtrate had been obtained, 10 c.c. of it were evaporated in a weighed platinum dish to a syrup, and ashed after addition of sulphuric acid, one-tenth being deducted.

(3) Ash by electrical conductivity. The 50 c.c solution, mentioned under (2), containing 10 grms. of sugar, was diluted to 100 c.c., and this solution was used for the ash determination in TÖDT'S apparatus. Since this instrument is

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[1] *Facts about Sugar*, 1923, 17, 552; *I.S.J.*, 1923, 436. [2] "Book of Methods," Second Edition, 180.

calibrated to show sulphated ash less 10 per cent., the results are on the same basis as those obtained by methods (1) and (2).

Methods (2) and (3) were thus used on the same portion of the sample, and the results are directly comparable, while those of method (1) are not.

We were able to finish determinations altogether on 87 sugars, all from different factories, most of them in Cuba, some in Porto Rico, and a few in other countries. The results are given in the accompanying table.[1]

	Chemical Method			Difference Between	
	Ash in sugar itself	Ash in soluble part	Electrical Method.		
CUBA.	1.	2.	3.	3 & 1	3 & 2
Camaguey province—					
Average of 20 samples	0.599	0.588	0.584	—0.015	—0.004
Habana province—					
Average of 9 samples	0.429	0.421	0.427	—0.002	+0.006
Matanzas province—					
Average of 10 samples	0.442	0.449	0.447	+0.005	—0.002
Oriente province—					
Average of 15 samples	0.537	0.529	0.522	—0.015	—0.007
Pinar del Rio province—					
Average of 5 samples	0.412	0.416	0.414	+0.002	—0.002
Sta. Clara province—					
Average of 14 samples	0.456	0.452	0.449	—0.007	—0.003
Grand average for Cuba	0.502	0.499	0.496	—0.006	—0 003
PORTO RICO.					
Average of 9 samples	0.554	0.534	0.553	—0.001	+0.019
PHILIPPINE ISLANDS.					
No. 3	0.40	0.40	0.40	0.00	0.00
LOUISIANA.					
No. 6	0.42	0.42	0.43	+0.01	+0.01
OTHER WEST INDIES.					
No. 2	0.44	0.42	0.45	+0.01	+0.03
No. 75	0.80	0.83	0.83	+0.03	0.00
Grand average for all samples	0.509	0.504	0.504	—0.005	0 000

DISCUSSION OF RESULTS.

A glance at figures in the last column of the table shows that the agreement between soluble ash by the conductivity method and soluble ash by the chemical method is in general very good, especially if it is considered that duplicate determinations by the chemical methods often differ by 0·03 per cent. or even more. The average ash content of the 86 sugars is found identically the same, to the third decimal place, by the two methods. The individual results check exactly to the second decimal place in 24·4 per cent., within 0·01 in 57·0 per cent., within 0·02 in 80·2 per cent., and within 0·03 in 90·6 per cent. of all cases. This leaves only eight sugars in which the discrepancy was from 0·04 to 0·06. These samples will be investigated more fully later on.

Comparison of results by methods (1) and (2) shows that in a number of individual cases the soluble ash is apparently a little higher than the total ash, although for the average of all sugars we find a minus difference of 0·005. These discrepancies are probably due to the limited accuracy of the chemical method itself, and also to non-uniformity of the sugar, two different portions of the sample being used in the two analyses. Differences in the chemical method may further be caused by the fact, to which SCHWEIZER[2] has called attention, that reduction of the sulphates by the carbon formed during incineration of the sample may lead to low results.

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[1] Only the average results are here reproduced. [2] *Archief*, 1916, **24**, 214; *I.S.J.*, 1918, 138.

Decolorizing Carbons: Their Value in Sugar Refining.

A Reply to Suchar Process Corporation.

A. A. Blowski and J. H. Bon, of the staff of the Californian and Hawaiian Sugar Refining Corporation, Crockett, Cal., recently published[1] the results of their investigations into the value of refining sugar by means of decolorizing carbons. Mr. Leonard Wickenden, of the Suchar Process Corporation, of New York, replied to this.[2] But to the statements made by this chemist, Messrs. Blowski and Bon now issue a rejoinder, the substance of which we here give:—

Mr. Wickenden has mistaken the purpose of our study—for it was not, as he believes, to build up a case against decolorizing carbons. As a matter of fact, our paper presented so many favourable aspects of decolorizing carbons that publication would have been withheld had we desired to build up a case against carbons. Separating the points as well as can be done, they are discussed as briefly as possible, as follows:—

1.—Mr. Wickenden believes it incorrect in principle to wash the decolorizing carbons before studying their properties.

Most carbons, as purchased, contain soluble salts which would greatly reduce their value if put directly into sugar liquors, and some have a very acid reaction, which would render them destructive of sugar if used in the original form. As washing would greatly improve many of these, and would be inexpensive, it would be the logical course to follow in actual practice, and also in making comparative tests. Also, in practice a carbon between cycles, with each regeneration, would be washed.

Question of Non-Sugar Absorption.

2.—Mr. Wickenden says, "one of the chief criticisms of vegetable carbons repeatedly either made or implied, is that they do not absorb non-sugars," and he goes to considerable length to prove that such a view is wrong. His statement is incorrect, as we devoted almost an entire column to showing that decolorizing carbons have a very definite power of adsorbing mineral salts—even showing that in some cases this exceeds that of bonechar for the same conditions.

However, we do state that the method of refining with decolorizing carbons is so different from those used with bonechar that the actual elimination of non-sugars (in weight) would be negligible with carbons. In refining with carbons, the systems proposed by the manufacturers, and actually in use, provide for the filtration of the melted washed sugar and high purity remelt sugar only—the affination syrup—which contains the bulk of the non-sugars, being boiled to remelt sugars without carbon filtration. Carbon filtration of the affination syrup (as is done in modern char refining) is not even proposed by carbon manufacturers, presumably because, to obtain appreciable benefit, such large quantities of carbon would be required and such an extensive multiple-stage filter-press station would be necessary that the system would be far from economical. For this reason the following points should be noted:—

(*a*) As the raw-liquor and high-purity remelts which are filtered contain only about 10 to 15 per cent. of the non-sugars in the raw product, fully 85 per cent. of the non-sugars never even come in contact with the adsorption medium. Manifestly, there is no opportunity for the carbon to adsorb the 50 per cent. of non-sugars that is eliminated with bonechar.

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[1] *I.S.J.*, 1926, 203-208; 255-260.

[2] *I.S.J.*, 1926, 297.

(*b*) Only about 2 per cent. of decolorizing carbon (on raws melted) is used. As this is only about one-fiftieth as much adsorbing medium as is used in the bonechar process (with about the same ash-removal power per unit weight), it will be seen that the adsorbing capacity provided is very trifling. It is evident that, of the small quantity of non-sugars filtered, only a relatively small portion can be adsorbed.

(*c*) As only high-purity products are filtered, the concentration of non-sugars in contact with the adsorbing medium is very low. This, of course (according to well-known laws of adsorption), will result in a relatively small adsorption of non-sugars.

Any one of these conditions alone is sufficient to reduce the elimination of non-sugars to only a fraction of that obtained with char; with all three conditions working together, it is evident that the elimination will be reduced to a negligible quantity.

NUMBER OF REMELTS IN CHAR REFINING.

3.—Mr. WICKENDEN takes exception to the statement that, with the use of decolorizing carbons, it would be necessary to boil 140 per cent. more remelts than with the use of bonechar.

The calculation of this, which is based directly on refinery results, is very simple—all the essentials being given in our paper. This calculation will probably be made clearer when it is explained that all of the non-sugars in the raws (except those eliminated by adsorption and those diverted to soft sugar) must be boiled to remelts in order to be eliminated as molasses. The amount of these remelts that it is necessary to boil, therefore, is proportional to the quantity of these non-sugars.

But a brief description of the mechanism by which the use of bonechar reduces the amount of remelts that it is necessary to boil will be clearer than the calculation:—

In any refinery the main original source of material for remelts is the affination syrup (raw wash syrup), this commonly amounting to about 12 per cent. of the raws handled. In refining with decolorizing carbons the accepted procedure is to boil all of this material to remelt sugars (the remelted sugar to be later reboiled for granulated).

In modern bonechar practice, however, the customary procedure is to filter this material over bonechar, eliminate about 50 per cent. of the non-sugars, and so improve the material that it can be boiled directly to white granulated sugar. The syrup spun off this white granulated sugar (about one-half of the original volume of affination syrup) then becomes the starting point for the remelt system. At one sweep, therefore, this system of char filtering and boiling directly to white granulated sugar cuts the main source of remelts in half.

(The above outline is merely for the purpose of illustrating the mechanics of the bonechar process in reducing the amounts of remelts. Any exact calculation must be based on the quantity of non-sugars handled, as was done in the original paper).

TWO OR THREE STAGES NECESSARY.

4.—Mr. WICKENDEN states that a three-stage process for decolorizing washed sugar liquor is unnecessary, basing his statement upon two premises:—

(*a*) That commercial sugars are actually produced by a two-stage process. This means nothing unless the degree of washing and subsequent reboiling is known. Our conclusion was based upon the necessity for securing a granulated liquor equal in quality to that used by bonechar refiners. The standard of colour for white granulated sugar liquors set forth in our paper is actually reached in refinery practice, and is believed to be necessary for the highest quality of output. From the standpoint of a refiner considering the adoption of a new process, a lowering of standards could not be considered. In order to satisfy ourselves of the necessity of a three-stage decolorization process, we examined commercial sugars made by the two-stage carbon process. These, while passable in some markets, were decidedly inferior to the average bonechar granulated sugar, and could not safely be handled by large refiners who must be in a position to compete in all markets.

(*b*) That he believes our tests to be inconsistent among themselves because of the following facts which we brought out in our paper:—(1) A 98·2 per cent. decolorization of raw liquor produces a satisfactory granulated liquor. (2) In our "efficiency tests" we obtained 99 per cent. decolorization with single filtrations with carbons. (3) In similar efficiency tests with char we obtained only 96·5 per cent. decolorization.

We would call attention to the following facts which Mr. WICKENDEN has apparently overlooked:—

(*a*) Where he states that we obtained 99 per cent. decolorization with single-stage filtration with carbons (in one case the exact figure is 98·5 per cent.), this was accomplished with 4 per cent. carbon in one case and 8 per cent. in the other, while 2 per cent. is all that is recommended by carbon manufacturers and all that can be considered economical in practice.

(*b*) These tests were made for comparative efficiency studies only, and were therefore conducted under test conditions of 47·5° Brix, at which point the decolorizing efficiency of carbons is about 20 per cent. higher than at 60° Brix, which would be used in actual practice and which was used in the three-stage experimental run.

(*c*) Even if we disregard these test conditions, a two-stage process using a 2 per cent. carbon is not the same as a single-stage process using 4 per cent. for in the former case one filtration is with a partly exhausted carbon.

(*d*) It should be brought out that these "efficiency tests" referred to by Mr. WICKENDEN, while closely resembling the manner in which decolorizing carbons would be applied, bear no resemblance to the actual use of bonechar. Bonechar filtration, from its nature, is essentially a multiple-stage filtration. At the surface of the char in the filter the liquor is in equilibrium with the char soon after filtration begins, but as the liquor goes through the 20 ft. column of char it passes through innumerable strata of increasingly fresh material until it comes in contact with practically fresh char as it emerges from the bottom of the filter. For this reason the actual decolorization with bonechar in practice is far greater than indicated by the 96·5 per cent. result shown in the laboratory "efficiency test." Relative decolorizing power of various agents as shown by efficiency tests should not be confused with actual results obtained in practice, where the manner of application may be entirely different with the different materials.

CARBON DETERIORATION IN REVIVIFICATION.

5.—Mr. WICKENDEN comments on the lack of data upon revivification; and, because of this, questions some of our statements.

It is true that the study of revivification has not been included in our experimental work, as we lacked the facilities for this work. However, in estimating costs for our final conclusions we accepted the figures as actually advertised by carbon manufacturers. It is conceivable that these are too low, but it is doubtful if they are too high.

With regard to the statement that carbons decrease in filtration efficiency with continued use, the authorities for this statement are HORNE[1] and SAUER.[2] Accepting the results of such widely known investigators, cannot fairly be construed as basing our statements on "hearsay." According to SAUER, this decrease in the filtration efficiency of carbons is due chiefly to the accumulation of impurities—mineral substances and also fine carbon derived from the organic matter filtered and adsorbed out of the liquors. If Mr. WICKENDEN has found a way to overcome this, then he has made a decided and startling improvement in the industry.

Our conclusions are all based on carefully conducted experimental work, on accurate refinery results or upon statements by authorities of unquestioned standing. It has been our object from the purely selfish standpoint of our own information to determine both the advantages and disadvantages of decolorizing carbons, and we have endeavoured to point these out impartially as we found them. Those actually engaged in the refining of sugar, knowing its problems well, are in a particularly advantageous position to determine the weaknesses of such new developments. If the manufacturers of decolorizing carbons will take advantage of such criticisms to develop their product still more, it will probably secure a much more widespread use than it has at present.

The Determination of the Hydrogen Ion Concentration in the Cane Sugar Industry.[3]

By LOUIS BAISSAC, F.C.S.,
Sugar Technologist, Department of Agriculture, Mauritius

METHODS FOR THE DETERMINATION OF THE *pH*.

There are several methods for the determination of the hydrogen ion concentration (*pH* value), but the two more commonly employed are the electrometric or potentiometric, and the colorimetric. The potentiometric method will not be described in this bulletin. For current laboratory or industrial needs, the colorimetric method is quite sufficient, although not so accurate. It is much simpler and can be made use of by anybody in the sugar-house; it is in fact almost as simple as the use of litmus paper.

It is based upon the change of colour or shade which takes place when solutions of different indicators are submitted to gradual changes in *pH*. Most indicators show a maximum change for a small range in the *pH*.

Indicators (such as litmus, methyl orange, phenolphthalein, etc.) are weak organic acids (or bases) liable to form salts. In solution these indicators are dissociated exactly as mineral acids or salts and their anions (or negative ions) differ in colour from the dissociated acids. In an alkaline medium, the indicator forms a salt totally dissociated. In an acid medium, the free acid only is present and is but very slightly dissociated, this dissociation being reduced to a minimum if there is an excess of H ions present. At intermediate stages between these two extremes, there are mixtures of salts and undissociated acids and consequently mixtures of colours.

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[1] *I.S.J.*, 1920, 333.

[2] *I.S.J.*, 1923, **25**. 485; 1924, **26**, 27.

[3] Extracted from *Bulletin No 10. Scientific Series, Department of Agriculture, Mauritius* (the first half of this Bulletin consisting mainly of theoretical considerations explaining the *H.I.C.* and *pH* value are here omitted).

For example, let us consider the case of litmus, with which everyone in the sugar-house is familiar. Undissociated azolitmin, (the acid of its colouring matter) is red in acid solution whilst the neutralized and totally dissociated salt is blue. Between these extremes, there are mixtures of red and blue—all the purple shades—each one corresponding to a certain *pH*. When half the colouring radical is dissociated, the colours are in equal proportions, and the slightest change in the *pH* will show a rapid change in the resulting shade. All indicators behave similarly. This is the basis of the method of the determination of *pH*, and when the indicator is a weak basis the phenomena are the same, but reversed.

The following is a list of a few indicators with their extreme *pH* values, the first figure being the *pH* at which dissociation starts and the second that of total dissociation. A *pH* lower than the first figure does not modify the initial colour, nor in the same way does a *pH* higher than the second one.

Indicator	Concentration Gms. 100 c.c.	Change of Colour	Limits of *pH*.
Bromo-phenol blue	0·04	from yellow to blue	3·0— 4·6
Methyl orange	0·02	,, red to yellow	3·1— 4·4
Methyl red	0·02	,, red to yellow	4·4— 6·0
Bromo-cresol purple	0·04	,, yellow to purple	5·2— 6·8
Bromo-thymol blue	0·04	,, yellow to blue	6·0 — 7·6
Litmus (azolitmin)	—	,, red to blue	4·5— 8·3
Phenol red	0·02	,, yellow to red	6·8— 8·4
Cresol red	0·02	,, yellow to red	7·2— 8·8
Phenolphthalein	0·05	colourless red	8·3—10·0

It will be noticed that the indicator the more commonly employed in the sugar factories in Mauritius, litmus, is the one with the widest range, which makes it the least sensitive.

The *modus operandi* for the determination of the *pH* of a solution by the colorimetric method is as follows:—10 c.c. of the solution are measured in a test-tube (16 mm. diam.)[1] to which are added from 0·3 to 0·5 c.c. of the suitable indicator. The same volume of the solution is measured in another test-tube; but in this one no indicator is added, the two tubes being then placed in a wooden "comparator" block one near the other. A test-tube filled with pure water is placed in front of the tube containing the solution with the indicator and in front of the other is placed the tube filled with a "buffer" solution of a known *pH*, coloured with the same indicator; when the shade of the solution is the same as that of the buffer, the solution is of the same *pH* as the buffer.

The most convenient buffer is composed of a salt (Dr. E. B. R. PRIDEAUX's formula) of which a certain weight is dissolved in one litre of pure neutral water. The *pH* of the solution is constant; by the addition of known volume of 1/5 normal solutions of hydrochloric acid or caustic soda, the *pH* of the original buffer solution is modified to the required *pH*. A set of buffer solutions with a constant difference of 0·2 *pH* is prepared, and the suitable indicator is added.[2]

A convenient comparator is the one described by MANSFIELD CLARK.[3] It may be made from a block of wood, in which 6 deep holes just large enough to hold ordinary test-tubes are bored parallel to one another in pairs. Adjacent pairs are placed as close to one another as can be done without breaking through the intervening walls. Perpendicular to these holes and running through each pair are bored smaller holes through which the test-tubes may be viewed. Before use, it is well to paint the whole block, and especially the holes, a non-reflecting black.

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[1] Test-tubes must be of first quality neutral, colourless glass; ordinary glass gives up alkalinity even to pure water and is objectionable.

[2] The standards so obtained will keep pretty well in sealed tubes.

[3] "The Determination of Hydrogen Ions," p. 70, 1922.

APPLICATION OF THE COLORIMETRIC METHOD.

H. F. BREWSTER and W. G. RAINES[1] instead of using test-tubes and a comparator, employed the drop-plate method adding one drop of the appropriate indicator solution to three drops of the test liquid contained in the depression of a porcelain spot plate. The colour thus obtained was matched with similar spots made by adding one drop of the same indicator to three drops of a standard buffer. The comparison with buffers is valuable especially when the solution to be tested has a *pH* which does not permit of the use of bromo-thymol blue.

For quick and approximate determinations ($\pm$ 0·1 *pH*) the comparison with CLARK's colour-chart is good enough. Mr. R. G. W. FARNELL,[2] research chemist of the British Empire Sugar Research Association applies it as follows:—To 2 c.c. of juice or 1 c.c. of syrup (clairce) measured in a test-tube and diluted to 10 c.c., with neutral water (*pH* 7·0)[3]; 0·3 to 0·5 c.c. of the required indicator are added; the tube is placed in the comparator and the colour is compared with that of the chart for the indicator employed.

Dilution does not modify the *pH* much, particularly with neutralized juices and raw syrups (clairces), in which cases the determination of the *pH* with bromthymol blue and matching with the colour chart is accurate enough.

When dealing with mill and sulphured juices, acidified syrups (*clairces*) and limed filter-press juices, the *pH* is not much modified by dilution; but matching is sometimes difficult because the colours do not agree exactly. The operator must use some imagination and discretion to judge of the difference of colours and find the agreement between the shades.

PRACTICAL CONSIDERATIONS FROM THE RESULTS OBTAINED.

It has already been seen that a juice neutralized to litmus settles more quickly than when neutralized to phenolphthalein. This is due to the fact that in the first case, the *pH* of the juice is nearer to the optimum at which colloids settle readily. When lime is gradually added to a sulphured juice (*pH* 3 to 4) it combines with the sulphurous acid to form calcium sulphite and with the acids pre-existing in the juice. As the *pH* increases, that is to say, as the acidity is lessened, the colloids coagulate until a point is reached when they rapidly settle leaving a clear supernatent liquid. According to research made in other cane countries, and observations made this year in Mauritius by FARNELL and the writer, this optimum *pH* is very near 7·0. If the amount of lime is increased, the colloids expand, are more hydrated and bulky, the more so as the *pH* is increased. As phenolphthalein begins to show a pink shade at *pH* 8·5, it is obvious that the settling will be slower if this indicator is made use of, and that the colloidal deposit is more bulky than in the case of litmus.

In Mauritius the juice is first sulphured, then limed. The man-in-charge of the liming, locally called a *sucrier*, adds lime to the juice up to a slight alkalinity to litmus. He takes a sample of the juice so treated in a glass or test-tube and observes the flocculent precipitate formed. According as the precipitate settles more or less rapidly, as it is more or less bulky, and as the supernatent liquid is more or less clear, he is satisfied with the liming point. If not, he adds some more lime in the tank if he considers it necessary. On the other hand if he thinks too much lime has been added, he will put less in the following tank. This man-in-charge is unaware that he has established the optimum *pH* of that particular juice. The figure seems very constant for a factory dealing with canes of the same locality. If the man-in-charge is expert he will retain the optimum *pH*, and the resultant clear juice will be satisfactory. He will use litmus paper only occasionally.

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[1] *I.S.J.*, 1923, 88. [2] *I.S.J.*, 1925, 89, 141.

[3] Distilled water is usually acid and the *pH* of natural waters—spring, river or well—is very variable. Mare-aux-Vacoas water, for instance is alkaline: *pH* 8·5—8·6. It is very easy to neutralize any water to *pH* 7·0.

There are cases when this *modus operandi* is defective, with very dark coloured canes, for instance. The man in charge is puzzled, and is inclined to use too little lime because of the dark colour of the supernatent juice. In such cases, the determination of the *pH* with bromo-thymol blue may help. At all events, the determination of the *pH* permits one to obtain more regularly a clear juice, and does away with the adeptness of the *sucrier*.

In 1923, the writer was asked to follow the application of the Bach process at Highlands.[1] He noticed that the filtration of the treated syrup was irregular and sometimes very difficult. Constantly good filtration was obtained when he applied the determination of the hydrogen ion concentration (*pH* 6·8 to 6·9). Litmus was not reliable. It was impossible to judge by the settling of the precipitate, for the latter was composed almost exclusively of calcium sulphite and a very small percentage of colloids. If sulphitation was stopped when litmus showed a light blue shade, inversion occurred, and when phenolphthalein was employed as indicator, filtration was almost impossible. But the determination of the optimum *pH* solved the difficulty.

CONCLUSION.

Amongst many others, there are two important points to be watched during the manufacture of sugar: excess of active acidity, causing the inversion of sucrose; and excess of active alkalinity, which decomposes reducing sugars.

Inversion is a cause of loss dreaded by the practical man, and destruction of reducing sugars is also a cause of loss which should be feared, for any destruction of them means the retention of about an equal amount of sucrose by salts in final molasses, according to PRINSEN GEERLIGS' unquestionable theory.

There is a rather narrow range of *pH* between the beginning of inversion and the destruction of reducing sugars, especially when the sugar solution is of a low specific gravity and at a high temperature, but the application of the determination of the hydrogen-ion concentration at successive stages during the manufacture of sugar permits of their prevention.

"One fact, however, is encouraging,[2] namely, that under tariff protection the Philippines can produce and deliver sugar to the United States market at a lower production cost than any of the world's producing centres, and present-day prices, having dropped below the production-cost figures of many of our competitors, must, if they are to move at all, move upwards."

In 1925 the HAWAIIAN COMMERCIAL AND SUGAR CO. (Puunene mill), produced 67.726 tons of 96° raws from 477,539 tons of cane, that is, 7·05 tons of cane to a ton of sugar, the average yield of cane and sugar being 71·11 and 10·09 tons per acre. In the factory the cane ground per hour averaged 65 12 with an extraction of 97 23, the fibre content being 12·17. Losses: in bagasse, 2·7349; in filtration, 0·4640; in molasses, 5·0928; and undermined, 0·0620 per cent., a total of 8·353 per cent.

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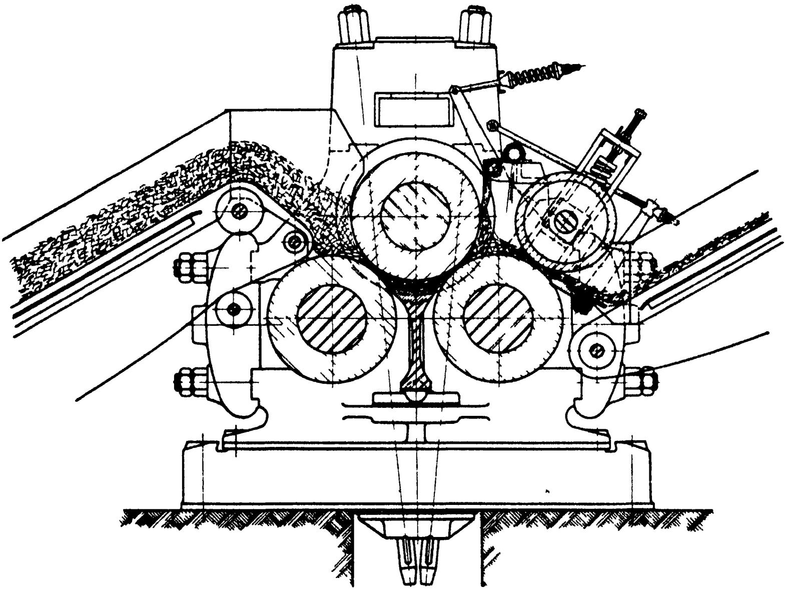
[1] *I.S.J.*, 1925, 555.

[2] *Sugar News* (editorial), 1926, 7, No. 4, 206,

The Burunat Imbibition Roll.

The Burunat Imbibition Roll (the invention of A. M. **Burunat**, of Central Isabel, Cuba), particulars of which have already been given in this journal,[1] has now been placed on the market, and we understand that it will be manufactured exclusively by the Farrel Foundry & Machine Company, of Ansonia, Connecticut.

The function of this roll is to provide better penetration of the maceration fluid into the blanket of cane. One of the inconveniences met with up to the present in maceration is that the maceration water on falling over the layer of bagasse as this comes out of the rollers does not penetrate the entire thickness of the bagasse but only a portion of it. With the Burunat Roll, the bagasse on leaving the mill receives the charge of imbibition water, and the bagasse and imbibition water are then compressed between the imbibition roll and the bagasse roll, the imbibition water being uniformly distributed throughout the mat of bagasse. The springs regulate the pressure so that any quantity of water may be uniformly distributed throughout any quantity of bagasse, permitting a perfect saturation of the fibre from the outlet of one mill to the inlet of the other, and obtaining an increase in sucrose extraction. After the bagasse has been compressed, it does not expand again but forms into the thin blanket that tends to increase the amount of cane ground.



The roll is mounted on the discharge side of the mill and works against the bagasse roll, being driven from the mill itself. It ensures higher sucrose extraction with the same amount of maceration fluid, or the same sucrose extraction with less water, and materially helps mills to take their feed. It keeps the inside of the carriers dry, and reduces the corrosion of carrier chains, while ensuring greater grinding capacity.

This roll is already being used successfully in Cuba. It can be employed with great satisfaction, we are informed, in combination with the **Petree** process, bringing about perfect contact of the special *cachaza* with the entire bagasse blanket to which this *cachaza* is returned.

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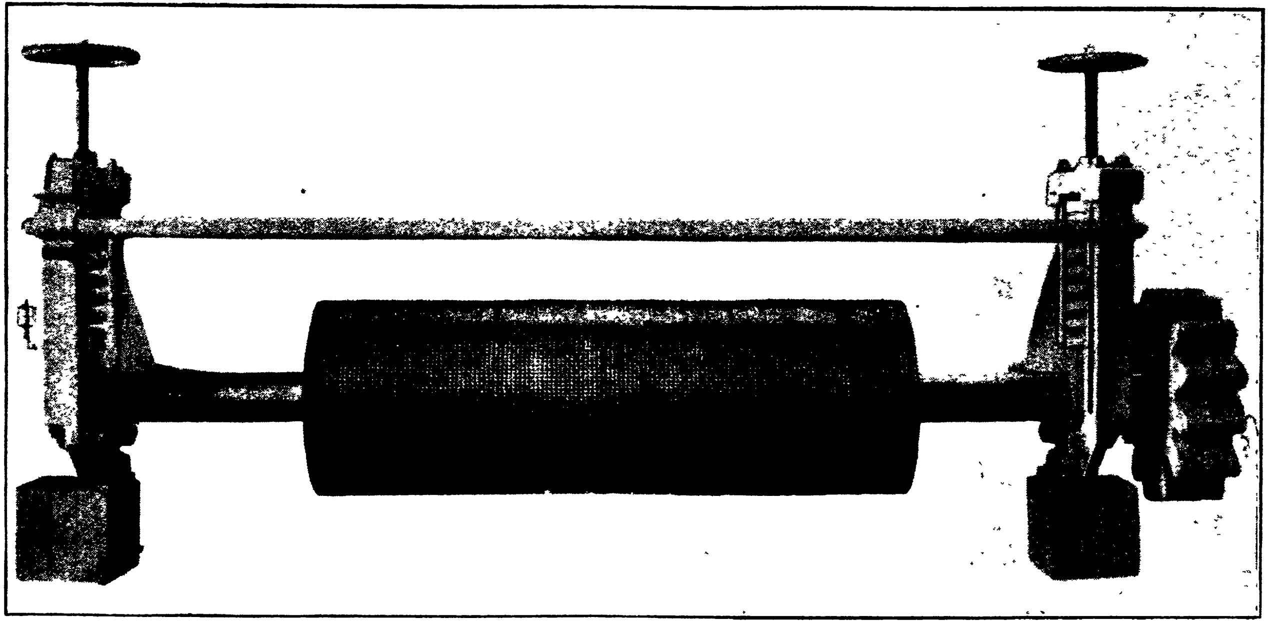
[1] *I.S.J.*, 1925, 111.



The Burunat Imbibition Roll.

British Beet Sugar Factories.

Annual Reports of the Anglo-Dutch Group.

The annual meetings of four of the factories in this country belonging to the Anglo-Dutch group were held last month, viz., those of Cantley, Ipswich, Ely and Kelham. A general survey of the results of the year in respect to them will be found among our Notes and Comments; we give below such data relating to the crop and the manufacturing results as were given out to the shareholders.

English Beet Sugar Corporation.—The number of growers who supplied roots to Cantley during the 1925-26 season was 2344, the produce of 15,897 acres, an increase as compared with the previous season of some 20 per cent. The average sugar content of the roots was 16·73 as compared with 16·74 the previous year. The average price paid for the roots was 57s. 3d. per net ton delivered, or 10s. per ton in excess of the minimum price laid down in the Subsidy Act. This compares with a price in 1924-25 of 47s. 2d. *plus* a special bonus of 5s. per ton, in all 52s. 2d. per ton. The growers delivered 130,558 tons of roots to the factory, while Kelham transferred 4554 tons to Cantley to save unremunerative operations. Cantley worked up in all 127,319 tons (or the largest amount in its history), the balance of roots delivered being transferred to Kelham, Ely and Ipswich. The white sugar produced was of high quality and was easily sold; the whole of the beet pulp by-product was taken by the farmers for use as feeding stuff; while the molasses output was all sold.

Ipswich Beet Sugar Factory, Ltd.—Growers numbered 658; the acreage under roots was 4059, the average sugar content being 17·43 per cent. In addition, the Yeovil district of Somerset sent their crop of 793 acres, the roots of which averaged approximately the same percentage as the East Anglian roots. The average price paid to the farmers was 53s. 11d. per net ton delivered, or 5s. per ton in excess of the minimum allowed under the Subsidy Act.

The construction of this factory was only commenced on March 1st, 1925, but it was ready for the manufacturing season in October; it was, however, found undesirable in many ways to allow so short a time for the erection of a factory, the attempt being attended with grave risks. The factory cost £476,000, of which sum £346,000 or 73 per cent. was spent in British labour and plant.

Ely Beet Sugar Factory.—Ely took 12 months to construct and as completed was larger than was originally contemplated. The total cost was £618,000, of which £457,755 (75 per cent.) was spent in this country. Seventy-seven different British firms supplied machinery and equipment, apart from building material.

For the first campaign 56,338 tons of beets were delivered by 1179 growers from 5641 acres, the average sugar content of the roots being 15·27 per cent. The average price paid the growers was 48s. 3d. per net ton delivered or 5s. in excess of the minimum. In addition, Ely dealt with some 23,841 tons of beets sent there from other factories in the group. The largest tonnage dealt with in any one day was 1700 tons. Some 800 men were employed at the factory during the campaign. The white granulated sugar made was of good quality and found a ready market.

Kelham Beet Sugar Factory.—Growers numbered 1514 with a total of 51,844 acres and 36,757 tons of roots, the average sugar content being 16·2 per cent., compared with 16·7 the previous season. The average price paid to the farmers was 55s. 9d. per net ton, or 10s. in excess of the minimum price, and 5s. 9d. more per ton than the previous year's price. According to the Chairman, Sir ERNEST JARDINE, Bt., the factory worked last season "like an old clock," and operated at its record capacity, viz., over 700 tons of beets per day, while on individual days over 800 tons was achieved. Local deliveries were however not ideal for the continuous running of the plant; they started later than anticipated, and reinforcements of beets had to be rushed to the factory from the Cantley area; Cantley, Ely and Ipswich in fact filled up all the gaps in delivery at Kelham, till when unexpected frosts came at the end of the season, delivery became so uncertain that the factory closed down prematurely to avoid heavy losses and sent the remaining deliveries of roots to Cantley. If nothing else, the past season has demonstrated the advantages of working in co-operation with other factories, so as to maintain an even supply of roots.

Publications Received.

Evaporation. Alfred L. Webre, M.E. (assisted by C. S. Robinson). 500 pages. (The Chemical Catalog Co., New York.) 1926. Price: $6.00.

This book follows soon after the publication of Badger's "Heat Transfer and Evaporation," also one of The Modern Library of Chemical Engineering[1]; but, whereas the earlier volume was of interest more to the theorist, the one now before us will certainly appeal to the practical sugar man, and will, we are confident, be duly appreciated by him. It has obviously been written by an engineer who has had considerable experience in the design, construction, and operation of evaporating plants of various types. This was shown by Mr. Webre's earlier publication,[2] but the present volume is a more comprehensive treatise. In the theoretical section there are 20 chapters covering considerations as transmission of heat; conductivity of surface films; heat balance; vapour heating; vapour compression; entrainment; circulation; steam belts; and condensation. On the practical side there is information on the operation of evaporators; shutting down and cleaning; scaling and fouling; condensate and non-condensible gas removal; practical working of jet condensers; vacuum pumps; and accessories. There are two other sections, the first on applications to various industries, in which one chapter is devoted to the heat balance in the beet factory, and another to the same question in the cane factory. Lastly, there is a section on types of evaporators and pans. Mr. Webre's book can be well recommended as a very serviceable work on the important subject of evaporation. A copy of it should be in every sugar factory and refinery library.

Industrial Fermentations. Paul W. Allen, M.S., Ph.D. (The Chemical Catalog Company, Inc., New York.) 1926. Price: $5.00.

The preface of this book explains that its object is "to bring together in a general way some of our present information concerning the application of micro-organisms." This it certainly does. But the information given covers a very wide range, there being 31 chapters devoted to as many different products of industry, some of these being: Industrial alcohol; legume cultures; disinfectants; organic-acid production; acetone; glycerin; corn products; food preservation; canning; cane and beet sugar; bread; fruit juices; drinking water; soil, etc., the result being that the treatment given is in general somewhat scanty. Under "Cane and Beet Sugar," excerpts from Owen's *Louisiana Bulletin 125* are given; but taken as a whole this chapter will not give either a very exact or a very complete idea of the present condition of "micro-organisms in the sugar industry." A more satisfactory chapter is that on "Corn Products," but there also some of the information printed might have given place to more important data that are absent. In treating "Industrial Alcohol," "Soil Microbiology," and also "Maple Sugar and Maple Syrups," the author has included a good deal of useful matter, some of which, however, hardly seems germane to the subject in hand, viz., the application of micro-organisms. Rum, whiskey, beer, and wine production find no place in this book from the land of Prohibition!

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[1] *I.S.J.*, 1925, 269. [2] *I.S.J.*, 1924, 551.

Coal and Ash Handling Plant. By John D. Troup, M.I.Mech.E. (Chapman & Hall, Ltd., London, W.C.2.) 13s. 6d. net.

This very readable work, by the Editor of the *Engineering and Boiler House Review*, is a comprehensive survey of all the problems involved in the mechanical handling of fuel and ash at a modern power house; it collects in one volume the available data on coal and ash handling plant which concern the power house and boiler house engineer in both large and small plants. The sections include Handling Coal on Delivery, Automatic Coal Weighing, Coal Storage, Coal Conveyors, Ash Handling Plant, Aerial Ropeway Conveyors, Flue Dust Removing Plant, and Recovering Unburnt Fuel. Emphasis is laid on the economies possible by the scientific control of combustion, and it is made clear that the actual cost of lifting fuel by mechanical means is very small in relation to the human cost for similar work; mechanical output is vastly superior to man-output. Some very interesting apparatus has been evolved in recent years for dealing with ash and clinker, and for expeditiously removing flue dust; and these are dealt with in the chapters on the subject. Finally, it may be noted that in the chapter on recovering unburnt fuel from the ash, the manufacture of building bricks from clinker is advocated and described. The book is well illustrated by numerous plates showing the different types of plant in use in commerce; but rather unfortunately, we think, there is no index to these illustrations.

Kempe's Engineers' Year-Book for 1926. Compiled and edited by H. K. Kempe, M.Inst.C.E.; M.I.Mech.E.; M.I.E.E.; and W. Hanneford Smith, F.R.S.E.; M.Inst.Met. Crown 8-vo., limp leather binding. (Crosby Lockwood & Son, London). 1926. Price: 30s.

This well-known reference book for all engineers is now in its 33rd edition. It contains over 3000 pages with 2500 illustrations, and from year to year is carefully revised to date. It covers: general mathematical tables, and formulæ; statics and dynamics; surveying; heat, properties of gases, sound, light and optics; weights and specific gravities, strength of materials; beams, girders, columns, roofing, etc.; bridges; timber beams, roofs, floors, etc.; building materials and construction; clays and allied products used by engineers; reinforced concrete construction; earthwork, chimneys, dams, etc.; railway construction, locomotives; electric traction; construction of engineering workships; irrigation works; waterways; steam generating plant, etc., etc. It is a uniquely authoritative publication, its compilation being brought about by an imposing board of associate-editors and contributors, each recognized as a specialist in his particular line of work. It can be said that "Kempe's" is a library in itself; and that any engineer in any part of the world possessing this volume alone will find himself able to meet most demands made upon his knowledge. It is a veritable encyclopaedia, indispensable to all engineers.

Reports of the Progress of Applied Chemistry, issued by the Society of Chemical Industry. Vol. X. 1925. (Society of Chemical Industry, Central House, London, E.C. 2.) Price: 7s. 6d. to Members of the Society; and 12s. 6d. to Non-Members. 1926.

It is hardly necessary again to draw the attention of readers to the importance of these Annual Reports. This year again Messrs. EYNON and LANE contribute the section on "Sugars, Starches and Gums," and a very able summary of the work done during 1925 in cane and beet sugar manufacture and refining it is. But for the sugar technologist the value of the Reports is the opportunity it gives of following the progress realized in allied lines of research, and for this reason the sections that are of most interest are: "Soils and Fertilizers"; "The Fermentation Industries"; "Foods"; "Fuel"; and "General Plant and Machinery."

"Suma-Therm."

Acid, Alkali and Heat Resisting Paint.

IRON CONTAMINATION.

Researches carried out by different chemists, notably by ZERBAN,[1] have shown the great importance of avoiding iron contamination in white sugar manufacture, in table syrup production, and in refining. Slight traces of iron in juices and other products suffice for the formation of a very dark colour, or for its intensification. SCHNELLER[2] has pointed out that the dark shade of some plantation white sugars (which may increase on storage) is due to the presence of compounds of iron and tannins or polyphenols.

It therefore happens that, in spite of careful clarification of the juice, and also of the syrup going into the pan, the sugars are often dull. There is no doubt at all that, if it were not for the contact of the juices and syrups with the iron of pipes, settling tanks, pumps, juice-heaters, filters, crystallizers, etc., the colour of most white sugars would be much improved, whiter and brighter crystals being then obtained.

REQUIREMENTS OF A HEAT RESISTING PAINT.

A generally reliable and economical heat resisting paint for the purpose of protecting the iron surfaces exposed to factory and refinery products has long been wanted. None appears to have come into general use. Such a paint should show no sign of any effect after plates treated with it have been immersed in boiling sugar liquor, in boiling caustic soda, and in boiling phosphoric acid (both 5 per cent.). It should contain no deleterious constituent, as arsenic, lead or zinc; it should adhere firmly to the treated surface; and it should not blister or crack after having been in use for some time.

Recently tests were made with about 36 preparations all claimed by their makers to be suitable for the purpose in view; but an unsatisfactory result was obtained in every case excepting one, which was a costly varnish. Most of the paint and varnish films softened in hot water alone, or failed to resist the effect of hot alkaline molasses liquor, or showed "pitting" after having been in use for a comparatively short time. Bitumen, asphalt and tar paints were proved quite unsatisfactory in general, usually failing even to withstand the effect of water above 70°C. without softening and blistering.

PREPARATION OF A SATISFACTORY PAINT.

After considerable experimenting, good results were obtained with a paint preparation containing, instead of linseed oil, a medium which evaporated leaving an inert substance, such as graphite or silica, as a dry adhesive film on the treated surface. By adjusting the various constituents of the mixings, a paint was eventually obtained capable of complying with all the requirements stated above of a reliable acid, alkali and heat resisting paint. This preparation, now named "Suma-therm," forms an entirely satisfactory medium for protecting all iron surfaces in the sugar factory or refinery. It has a considerable covering power, and is sold at a sufficiently low price to enable universal use to be made of such a protection. Black is recommended for general purposes.

APPLICATION OF "SUMA-THERM."

Particles of loosely adhering rust and dirt, if present, should of course be removed, but it is advantageous to have a fine film of rust on the surface, rather than to have it quite bright. Two thin coats (which quickly dry) are applied, not one thick one, the paint being well brushed in. During operations the usual precautions in regard to avoiding the proximity of naked lights should be taken, though the preparation is not more inflammable than many others (its flash point being 80°Fah.). Just before use it is essential that the mixture be thoroughly well stirred until homogeneous.

A protective surface is thus provided, which is durable, and capable of solving in an efficient and economical manner the problem of preventing the discoloration by iron of factory and refinery products. One gallon covers about 80 square yards of surface; and the paint is shipped in iron drums, each containing 7 gallons, and weighing about 112 lbs. net. It is sold only by The Sugar Manufacturers' Supply Co., Ltd., 2, St. Dunstan's Hill, London, E.C. 3., who will submit samples.

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[1] *I.S.J.*, 1920, 55; 1921, 32.

[2] *I.S.J.*, 1919, 184.

Brevities.

A bleaching powder containing as much as 42-45 per cent. of available chlorine has been prepared by S. **Ochi**, whose work on the bleaching of sugar solutions was recently described.[1]

Recent statistics[2] show that the sugar industry in the State of Sao Paulo, Brazil, at present comprises 18 mills, employing 2,581 hands and a capital of 19,771 contos.[3] The motive power used by these mills amounts to 7,095 h.p. These figures do not include small rural mills, the production of which is almost negligible.

G. F. **Kullgren** and S. G. **Lind**, of Stockholm, claim to have found that a preparation of colloidal silica is very efficient in respect of removing colour from saccharine juices. Their preparation can be dried and disintegrated to a certain size of grain. Its adsorbing power is claimed to be even greater after heating to 550°C.

A new denaturant has been authorized for alcohol by the Italian Government, this being prepared by mixing purified light ichthyol oils with other substances in varying proportions, and being added to the alcohol at the rate of 3 per cent. This supersedes the mixture of pyridine, methyl alcohol, acetone oil and benzol formerly official.

In Argentina it is reported[4] that pressure is been exercised in certain circles of the sugar industry with a view to obtaining legislation of a protective nature in support of the producers' interests, said to be menaced by importations from abroad. The high cost of local production, which has subsisted since the days of the war, renders it at times difficult to compete with the produce of other countries, where such costs have declined to pre-war levels.

In the 1924-25 returns, relating to the beet sugar industry in France,[5] recently published in Paris, it is reported *inter alia* that the number of factories operating was 107; that the yield has risen from 11·57 to 12·23 per cent.; that the price for the pulp was 9·61 francs per metric ton; that the number of working days was 99·9, in place of 81 for the previous season; and that the average rate of payment to men, women and children employed during slicing was 24·23, 14·02 and 11·80 francs respectively. Regarding cost data per quintal of sugar, this works out at 118·74 francs for raw material; 10·88 for fuel; 8·48 for general labour, giving a total figure of 138·10 francs, from which one deducts 3·88 francs, the credit arising from the sale of pulp.

We much regret to notice the death of Mr. J. W. **Macdonald**, Vice-Chairman of Tate & Lyle, Ltd., London and Liverpool, who had been prominently associated with that business, and with Henry Tate & Sons, Ltd., during 50 years past. The deceased was the son of a sugar planter of St. Vincent, B.W.I.; he was educated at Greenock, Scotland, where he studied under the well-known chemist, Dr. **Wallace**, of that town. His analyses of the sulphated ash from cane and beet sugars, familiar to chemists, were made about that period.[6] He was for many years manager of Henry Tate & Sons' refinery at Liverpool, and in 1903 was made a Director of that Company, transferring his activities to their London refinery. Mr. Macdonald was regarded as an exceptionally able sugar technologist, who likewise was well familiar with the statistical and commercial sides of the refining industry. He served as Member of the Indian Sugar Committee,[7] appointed in 1919, and also of the Empire Sugar Supply (Technical) Committee, which made its report in the same year.[8]

Dr. E. W. **Allen**, Director, Office of U.S. Experiment Stations, in a recent article[9] reproduced the following quotations in a paper advocating "Research in the Service of the State":—"Research itself is a process of learning." . . . "Agricultural prosperity cannot be assured through special legislation, but sound advancement must rely on sound knowledge of scientific and economic principles to be worked out through research." . . . "The Experiment Station, that powerful agency for applied science which has few counterparts, and which steadily has spread to every civilized civilized country . . ."

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[1] *I.S.J.*, 1926, 273.

[2] Bank of England and South American *Monthly Review*.

One conto = 1000 Brazilian dollars (2s. 2·9d. to the dollar at par).

[4] Bank of London and South America *Monthly Review*.

[5] *Circ. hebd.*, 1926, 229.

[6] *Chemical News*, 1878, 37, 137.

[7] *I.S.J.*, 1919, 605.

[8] *I.S.J.*, 1919, 366, 448.

[9] *Science*, August, 1925.

Brevities.

It is reported that the Japanese Government has offered 65,000 yen, or about £6000, to defray the cost of testing the chlorination process of Mr. SHUICHIRO OCHI,[1] on the semi-industrial scale. The inventor proposes to build a small refinery with a sugar capacity of 5 tons a day.

Dr. A. V. BLOM, of Berne, claims to have discovered a lead pigment which when applied to iron produces a surface which will not rust.[2] This pigment is stated to be exceptionally adhesive, and iron sheets treated with it have withstood the action of steam and are said to have been very successful.

Mr. DUNCAN SHAW, of Wemyss Bay, formerly a partner in the firm of John Walker & Co., sugar refiners, of Greenock, died recently in Glasgow, at the age of 85. He left about £30,000 in public bequests, principally to Greenock institutions. Mr. W. MURRAY SCOTT died recently in London at the age of 56. He was formerly manager of the Quarry Bay Refinery, Hong-Kong, and was a technologist of high reputation.

In a contract note made by the Great Lakes Sugar Co., with farmers supplying roots[3] certain of the clauses are to the effect that at least 15 lbs. of seed per acre must be planted, this being supplied by the Company at 15 cents per lb.; that the Company will not be liable to receive roots testing less than 12 per cent.; and that the price paid for the roots shall be $7·00 per ton, when sugar is $6·00 per 100 lbs. Other conditions specified relate to harvesting, delivery, and weighing.

The Great Western Beet Sugar Co., of Denver, Colo., U.S.A. are directing a vigorous advertizing campaign in favour of their product, this being a special appeal for the making of jams and jellies by the housewife.[4] White beet granulated is called "the jelly making sugar"; and other extracts from a very attractive page display are: "a sugar of proved quality"; "housewives. . . . . would not go back to any other sugar. . . . . once they have tried Great Western"; and "the finest sugar."

H. V. RENN, late of Duroglass, Ltd., has collated the results of tests on the relative value of different types of laboratory "resistance glass."[5] In one of these, the glass vessels containing 250 c.c. of water were subjected to steam for 3 hours, and the loss of weight determined. "Pyrex" and Jena wares here showed up the best, whereas a certain brand of German glass gave a solubility figure more than nine times that of any of the others. In tests on the effect of alkalis and acid, an English glass ("R" Resistance) showed up particularly well, giving better results for all the reagents tried than either of the above two named. "Pyrex" came out in the breakage, being broken at 31 in. drop, whereas the figure for Jena which was next was 10 in. This brand was also best in the "thermal indurance" trials, in which vessels were submitted to a series of stringent trials, as heating to at least 100° C., and dropping into ice water.

The Report of the Proceedings of the Second Conference of the Association of Special Libraries, held at Balliol College, Oxford, in September of last year, has just been published.[6] Much useful work has been accomplished by the Association, and much is still in hand, in the direction of co-ordinating the sources of information in science, industry, commerce and public affairs. Highly interesting papers were contributed at the Conference: on Technical Intelligence by Major W. E. SIMNETT; on Technical Translations by H. I. LEWENZ, M.I.Mech.E.; on Filing by R. B. MATTHEWS, A.M.I.C.E.; on Patents by H. E. POTTS, M.Sc.; and on Abstracting by T. F. BURTON, B.Sc. In the course of the paper by the latter gentleman the following remarks were made: "Workers in chemistry and allied subjects are well—some think too well—catered for in this country. In chemistry itself, there are the "Abstracts in Pure Chemistry and in Applied Chemistry," published by the Bureau of Chemical Abstracts under the ægis of the Chemical Society and of the Society of Chemical Industry. Many of the special branches of applied chemistry have abstracts publications of their own, issued either by the respective societies themselves, or by private enterprise, a notable example of the latter being the *International Sugar Journal.*"

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[1] *I.S.J.*, 1926, 273, 332.
[2] *Zeitsch. fur angew. Chemie*, May 6th, 1926.
[3] *Sugar*, 1925, 111.
[4] *Through the Leaves*, 1926, 262-264.
[5] *The Industrial Chemist*, 1926, 270-273.
[6] *I.S.J.*, 1925, 499, 610.

Review of Current Technical Literature.[1]

STEAM GENERATION EFFICIENCY IN MODERN POWER PLANT. *Anon.* *The Industrial Chemist, 1926, 128.*

A typical example of what may be accomplished in large water-tube boilers equipped with mechanical handling, both of fuel and ash using both pulverized fuel and mechanical stoking, and with the aid of scientific methods of control, is shown by the fact of about 85 per cent. steam generation efficiency having been obtained during recent tests at the Grove Road, St. John's Wood, power station of the Central Electric Supply Co. in London. These were of 8 hours' duration, and the section of the plant under investigation consisted of a Babcock and Wilcox boiler described as having a normal evaporation of 60,000 lb. per hour, operating at 200 lb. gauge pressure and 625° super-heated steam temperature, having a heating surface of 8619 sq. ft., with 3190 ft. for the superheater. Also the equipment included a Green feed-water economizer of 4620 sq. ft. heating surface and an "Usco" multiple plate type air heater of 9130 sq. ft., with 110 thin metal plates electrically welded as usual within the outside casing, which is made in two sections. The boiler was fired by three "Underfeed Class A" travelling grate stokers, having a total grate area of 308 sq. ft., while both the forced and induced-draught fans are of the "Sirocco" type. The coal used was of most moderate quality, chiefly Scotch Washed Peas, with 13·6 per cent. moisture, and a calorific value, as fired, on the lower or so-called net heating value of 10,600 B.Th.U. per lb., and Stanley slack of 10·3 per cent. moisture and 10,000 B.Th.U. As typical of some of the detailed figures of the tests the flue gases contained 11·2 to 12·4 per cent. CO_2 and 6·0—8·5 per cent. free oxygen without any CO or unburnt products, while the temperature of the gases leaving the boiler varied from 540°—560°F. The economizer raised the feed water from 165°—170°F. to 250°—270°F., and the average temperature of the air entering the heater was 103°—107°F., corresponding to 237°—245°F., as delivered to the stokers, with an average velocity of 535—629 ft. per min. Further, the flue gases from the economizer entering the air heater at 346°—358°F. are finally reduced to only 255°—262°F. before discharging to the chimney base itself, a noteworthy figure, that for the ordinary Lancashire boiler for example being 450°—550°F. The efficiency works out between 83·2 per cent. to 85·8 per cent., based on the usual higher or gross heating value of the coal without deducting auxiliary power. If the fans and stokers are allowed for, the actual net efficiency—still on the higher heating value—is 82·4 per cent. to 85·1 per cent., while if the lower heating value of the coal is taken, that is with allowance for the hydrogen-content, the figures are 85·6 to 88·4 per cent., with the deduction of the auxiliary power, or 86·4 to 89·2 per cent. without. Also, 12 45 lb. of air per lb. of fuel were used for combustion, the theoretical figure being 8 50 lb., while the water evaporated per lb. of coal as fired is 7·235—7·889 lb., equivalent to 8·99—9·76 lb. from and at 212°F. In general, to-day mechanical stoking with water-tube boilers is obtaining results practically equal to pulverized fuel firing; and another lesson of these tests is the great value of air heating.

REMARKS ON THE QUESTION OF THE "UNDETERMINED LOSS" IN CANE SUGAR MANUFACTURE. *Hayward G. Hill.* *The Planter, 1926, 76, No. 16, 308-309.*

"An appreciable amount of the undetermined is due to the method of control and is an apparent loss only. Added to this, we have the inevitable actual undetermined loss which must take place in every factory, the inversion loss, entrainment, the unavoidable occasional spillage or leakage, each small, perhaps, but together making a definite figure. A reported undetermined loss of less than 0·100 per cent. on cane should be looked upon as extremely suspicious. An undetermined loss as low as for example 0·005 is on the face of it absurd, and is plain evidence either of accidental or intentional manipulation of figures. The latter is usually the case. The custom of padding figures to show a low undetermined loss is an unfortunate and rapidly spreading practice. It would not be so bad if it stopped with this figure only. But adjusting one figure has led to adjusting another; and, in an unreasonable race for low loss balances, a general manipulation of figures has become common in many laboratories, thereby destroying one of the principles on which the chemical control is based, and nullifying the benefits which might be derived from the work of this department. A pretty report is turned out nice to look at, perhaps, but nothing more. The harm that this is doing is difficult to estimate. It is unfair and detrimental to everyone concerned. Factory owners have been so thoroughly deceived that there are to-day owners who are paying bonuses to their fabrication superintendents on the lowness of their total losses, and therein is included an undetermined loss figure of 0·015 or the like. They will some day realize the fact that they are paying bonuses on a total loss account and sucrose balance arrived at by dishonest means. It is not fair to a well-equipped factory operated by an efficient personnel and turning out honest reports, that their results should be compared against the doped-up sucrose balance of some antiquated junk pile, whose manufacturing report only serves to hide the poor work of inadequate equipment and a lax personnel. To base the chemical control on true sucrose numbers determined by the Clerget method would require more elaborate equipment and larger technical force than is the custom to provide at present. Further, an efficient and useful control can be established on a direct polarization basis, giving comparative and valuable results. But it must be clearly and generally understood what are its limits and its possibilities, and it must be honestly and accurately applied. Action to the contrary will destroy the purpose for which it was designed, waste the money which is spent for its maintenance, and convert the laboratory into merely a machine for reporting previously decided results."

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TESTS FOR THE EVALUATION OF BONECHARS AND DECOLORIZING CARBONS. *A. A. Blowski and J. H. Bon.*[1] *Industrial and Engineering Chemistry, 1926, 18, No. 1, 34-36.*

Bonechars.—At Crockett Refinery the efficiency of the different grades of bonechar in process is determined by means of the following arbitrary tests :—Exactly 170 c.c. of the properly sampled material are introduced into a 500 c.c. Erlenmeyer flask containing 10 c.c. of dry "Filter-Cel" used for obtaining a clear filtrate ; 200 c.c. of a 47·5° Brix standard crystallizer remelt sugar solution are added, the mixture shaken for 30 seconds, and digested at 80°C. in the water-bath for 3 hours, shaking for 30 seconds every half-hour. After cooling rapidly, the liquor is decanted and filtered through paper overnight. A blank and a standard sample of bonechar, arbitrarily rated at 100 per cent. efficiency, are run in parallel with the bonechars being tested. Colour removed from each filtered solution is determined, and efficiencies are calculated on the basis of 100 per cent. for the standard product. Residues of the filtrates are used for ash removal tests, sulphated ash being determined, the ash removal efficiency being calculated on the basis of 100 per cent. for the standard bonechar. This char efficiency test is admittedly empirical, and does not duplicate conditions as they exist in the refinery, though it is believed that it reveals variations in the efficiency of the bonechar occurring from month to month. It is on a volumetric basis. *Decolorizing Carbons.*—On the other hand, the evaluation of a decolorizing carbon should be carried out gravimetrically, i.e., as a percentage by weight on the dry substance in the liquor ; and a series of tests (not a single one, which cannot yield sufficient information for basing an estimate of relative value) must be made. In these the percentage of carbon varies as the per cent. decolorization being determined in each case, and is plotted in the form of a curve (per cent. decolorization against per cent. carbon), this being known as a decolorizing isotherm. From a comparison of decolorizing isotherms for a number of carbons, obtained under identical conditions, an idea of the relative efficiencies of these materials may be obtained. In determining the relative decolorizing power, the procedure is as follows : 100 c c. portions of 47·5° Brix test liquor (washed 96° raw liquor or standard crystallizer remelt sugar liquor) are heated for one hour at 80°C. with amounts of carbon ranging from 0·5 to 10 per cent. by weight on dry substance in liquor, the flasks being shaken for 30 seconds at 15 min. intervals during the test to keep the carbon in suspension. At the conclusion of the digestion, the flasks are cooled rapidly and the contents are filtered through paper and "Filter-Cel," the colour of the filtrate being determined with a Stammer colorimeter, or by comparison with standards when too light to be read on the colorimeter. Per cent. decolorization is plotted against per cent. carbon, to obtain the decolorizing isotherm for the carbon under investigation. Efficiencies are calculated from the relative amounts of carbon necessary to effect an equal decolorization (say 80 per cent. on raw liquor and 50 per cent. on crystallizer remelt sugar liquor).

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[1] California and Hawaiian Sugar Refining Corporation, Crockett, Cal.

UTILIZATION OF SUGAR BEET BY-PRODUCTS. Herbert E. Woodman.[1] *Journal of the Board of Agriculture, 1926, 33, No. 2, 109-117.*

Beet tops.—Something like 5 tons of tops per acre, including about 1 ton of crowns, remain on the field after removal of the roots, analysis showing (per cent. of dry matter) crude protein, 17·52; crude oil, 2·27; carbohydrate, 53·25 (sucrose, 10·66); fibre, 8·86; and ash, 18·10 (sand, 3·29); the water content in the fresh material being 84·05 per cent. Beet tops are therefore an extremely watery food, containing on an average about 15 per cent. of dry matter; but its dry substance is very rich in protein and carbohydrate, the amount of the sugar depending on the proportion of crown to leaf in the tops. Fibre is low, and mineral matter is high, the latter being of course due mainly to adhering earth. Broadly speaking, beet tops show a closer resemblance to a succulent immature green fodder than to a roughage like hay, and a fodder the dry matter of which contains more than 17 per cent. of crude protein and nearly 11 per cent. of sugar is not to be despised by the stock-feeder. HONCAMP[2] has demonstrated that the organic matter of the tops is digestible to the extent of 79 per cent., and that 100 lbs. of this material (dry) has a feeding value equal to 54 lbs. of starch, a very satisfactory nutritive value. And KELLNER[3] states that "Liberal feeding with sugar beet tops . . . . . has the same effect as with good pasture or clover feeding, and gives a milk rich in dry matter and fat, because of the quantity of protein in the feed." It is to be noticed, however, that oxalic acid may be present to the extent of 4–5 per cent. of the dry matter, for which reason KELLNER advises adding precipitated chalk at the rate of ¼ lb. to 250 lbs. of beet leaves, so as to render this constituent insoluble. Other points to be noted are that, as beet leaves are laxative, they should always be fed with hay or chaff; and also that care must be taken when topping to remove adhering soil, in order to avoid introducing grit into the fodder. Beet tops may be preserved by artificial drying (means for doing which are here described), or by ensilage, the former being the preferable method. As to their manurial value, this works out at 7s. 3d. per ton when ploughed in, or 4s. 3d. when consumed by stock. *Beet pulp.*—In the fresh condition it contains 90–95 per cent. of water, which can be reduced about 10 per cent. by pressing. It contains: crude protein, 10·75 per cent. (of the dry matter); crude oil, 0·76; carbohydrate, 64·83; fibre, 19·62; and ash, 4·04, the water in the fresh material averaging 85·62 per cent. Excepting in regard to the fibre content, there is a general similarity in composition between this material and mangolds. Cost of transport limits the use of wet pulp, except to farms in the vicinity of the factory. It may be preserved in silos with or without beet tops, though this method results in large losses of nutrients, but preferable to this is drying in the factory by waste gases or steam, when a product results that can be kept over long periods. In respect of nutritive value, 1 lb. of dry pulp may be regarded as being equal to about 8 lbs. of mangolds.

AUSTRALIAN METHOD OF DETERMINING THE "COMMERCIAL CANE SUGAR" IN CANE. Anon. *South African Sugar Journal, 1926, 10, No. 4, 201.*

An important report has been published by the Board of Trade and Industries on the Sugar Industry in Natal, and one of the recommendations made is that a system of payment for cane based on sucrose content should be made to supersede the present mode of purchasing by weight alone, following, for example, the method of working adopted in Australia.[1] It is there laid down by law that for the purpose of determining the commercial cane sugar in cane, samples of cane juice shall be procured from the front roller of the first mill, the time in procuring such samples being not less than 3 mins. in each case, and during such time the sampling shall be continuous. Due precautions must be observed to prevent any maceration fluid or other juice finding its way into the samples for analysis. Where the Central Board decides that cane is to be paid for according to its commercial cane sugar, at least one sample shall be taken for every 30 tons crushed. The constituents to be determined by analysis shall be :—(*a*) The cane sugar or sucrose—by the polariscope. (*b*) Total soluble solids—by the Brix spindle. (*c*) Fibre or insoluble matter. As for the calculation of the "commercial cane sugar" this shall be made as follows :—

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[1] Annual Nutrition Research Institute, Cambridge.

[2] *Versuchs-Stationen*, 1916, 88, 305.

[3] "Scientific Feeding of Farm Animals," page 345.

$$\text{Total soluble solids in juice} \times \frac{100-(3+\text{Fibre})}{100} = \text{total soluble solids in cane.}$$

$$\text{Sucrose in juice} \times \frac{100-(5+\text{Fibre})}{100} = \text{Sucrose in cane.}$$

$$\text{Total soluble solids in cane}-\text{Sucrose in cane} = \text{Impurities in cane.}$$

$$\text{Sucrose in cane} \frac{\text{Impurities in cane}}{2} = \text{Commercial cane sugar.}$$

Cane sugar or sucrose and total soluble solids shall be determined in every sample. Fibre shall be determined at least once a week for each variety and each class of cane of each variety. For the purpose of the Act the word "class" means plant cane or first ratoons or other ratoons, stand-over crops to be taken separately from one-year-old cane.

BEET FACTORY HEATER SLIME. *A. Smolenski. Die deutsche Zuckerindustrie, 1926, 51, No. 10, 251-252.* Black slime from the inside of heaters used for raising juice to 80-85°C. was found to consist of 45 per cent. of proteins, 8 per cent. of ash and about 47 per cent. of other organic substances, including what is called a "glucuronide" of beet resinic acid, a strongly foaming saponin, believed to be a new non-sugar.—STANDARD METHODS OF ANALYSIS OF FERTILIZERS. *J. Sen. Bulletin No. 164, Agricultural Research Institute, Pusa.* Methods of sampling, and of phosphoric acid, nitrogen and potash determination, based largely on those of the A. O. A. C. are collected, and urged for acceptance as "official." —PRODUCTION OF ABSOLUTE ALCOHOL INDUSTRIALLY. *H. Guinot. Chimie et Industrie, 1926, 15, No. 3, 323-330.* An excellent survey of modern methods, developed largely in France, for producing 99·9-100 0 per cent. alcohol by rectification in the presence of hydrocarbons. During the past two years, 250,000 hectolitres of alcohol have been dehydrated in France according to the methods of the Distilleries des Deux Sèvres,[2] as compared with 30,000 made by other processes. It is predicted that the price of absolute alcohol will be little more than that of 95-96° if the methods here outlined, which demand little extra fuel, are followed. INCREASE OF COLOUR IN WHITE BEET FACTORIES. *Freda Hoffmann. Vereins-Zeitschrift, 1926, 91-98.* From thick-juice (evaporator syrup) to first massecuite, the increase of colour determined photometrically by the extinction coefficient averaged 47 per cent. (with extremes of 20 and 87 per cent.) of that originally present.—SOLUBILITY OF SUCROSE IN THE PRESENCE OF IMPURITIES *Julius Robart. Bulletin de l'Association des Chimistes de Sucrerie, 1925, 26, 43, 128.* Contrary to the results obtained by CLAASSEN, FRADISS, and others, who find the presence of beet non-sugar impurities to increase the solubility, the author reproduces results going to show that when favourable conditions are maintained the solubility is about the same as in the absence of these substances.—USING DOLOMITIC LIME IN THE BEET FACTORY. *Wenzel Kohn. Zeitsch. Zuckerind. Czechoslov., 1926, 50, Nos, 26-27, 209-215, 217-221.* Returning to this question[3] the author finds that when used to the amount of less than 0·4 per cent. of the volume of the juice, caustic lime from dolomitic limestone gives satisfactory results, the precipitate obtained settling to about 20 per cent. of its original height in about 30 minutes. But amounts exceeding 0·4 per cent. produce a mud which fails to settle.—COMPOSITION OF PECTIN. *W. H. Dorr.* *Journal Amer. Chemical Soc., 1926, 48, No. 1, 232-236.* A modification of the Lefèvre-Tollens[1] method for glucuronic acid has been applied to the determination of galacturonic acid in pectic substances Determinations made before and after extracting with 70 per cent. alcohol show no simple relation exists between galacturonic acid and furfural yield so obtained. A possible interpretation of the data is discussed with reference to Nanji, Paton and Ling's hexa-ring structure[2] for the basal unit of pectic substances.—IDENTIFICATION OF SUGARS, USING NYLANDER'S REAGENT. *O. Aschan.* *Comm. Phys. Math. Soc. Sc. Fenn (Helsingfors), 2, No. 8, 1-11;* through *Chimie and Industrie, 1926, 15, No. 5, 798.* Tabulations show the colours obtained on heating solutions of a number of sugars with Nylander's reagent, which is prepared by dissolving 4 grms. of Rochelle salts in 100 grms. of a 10 per cent. solution of sodium hydroxide, adding 2 grms. of bismuth subnitrate, and heating until most has gone into solution, then decanting the clear solution. These tables show that only when the CO or CHO group adjoins an OH does reduction with this reagent take place.—"RAPID" DIFFUSION PROCESS FOR EXTRACTING BEET JUICE. *A. Vasseux.* *Bulletin de l'Association des Chimistes de Sucrerie, 1925, 43, No. 3, 75-80.* A fair number of beet factories and distilleries have now put this continuous process[3] into operation, including Spalding and Kidderminster in England. Slices take only 30 mins. to pass through the apparatus, giving juice at 80–82°C. low in protein, with an average density of 14·6° Brix. Other points are: That there are no waste waters (as the expressed water is returned to the apparatus); that the loss of sugar is about the same as for the standard diffusion process, viz., 0·45 per cent of the sugar in the root; that consumption of water and fuel are both reduced; that frozen roots can be worked up without reducing the output of the plant. On the other hand, compared with ordinary working, more fine pulp finds its way into the juice, but this is hardly a disadvantage, as it is eliminated in clarification, and in the distillery such particles serve as points of attachment for the yeast.—EVAPORATION UNDER PRESSURE. *H. Claassen.* *Centr. Zuckerind., 1926, 34, No. 8, 174-175.* Pauly-Greiner's system of evaporation under pressure, (although lately much has been heard of the Vincik-Turek development due to two Czecho-Slovakian engineers) has been known and employed universally in the beet industry. According to the author, no economy in fuel has been observed in factories in which the V.-T. apparatus has been installed, compared with vacuum evaporators working under good conditions.—COMPOSITION OF BEET PECTINS. *F. Ehrlich and R. V. Summerfeld.* *Vereins-Zeitschrift, 1926, 203-204.* Partly a general exposé. But it has recently been found that pectic acid yields 12·8 per cent. of acetic acid by treatment with hydrochloric acid-alcohol; other products of hydrolysis are d-galacturonic acid (by boiling for five hours with 2 per cent. of sulphuric acid), l-arabinose, and d-galactose. Constitution of the pectic acid present in beets is: triacetyl-arabino-galacto-dimethoxy-tetra-glucuronic acid.—REFINING IN PORTO RICO BY THE "SUCHAR" PROCESS. *R. G. W. Farnell.* *Facts about Sugar, 1926, 21, No. 22, 512-513.* An outline is given of the procedure in the Porto Rican American Sugar Refinery, Mercedita, which is now producing a sugar sold under the trade mark of "Snow-White," stated to be superior to white granulated. Advantages of this process of carbon refining are: Smaller capital investment; lower working cost; great decolorizing efficiency; superior product; and great simplicity. "Originators . . . . have made a most important contribution to the progress of the technique of sugar refining." Author hopes to see it widely used throughout the sugar-growing sections of the British Empire.—PROPOSED BRITISH STANDARD TABLE OF WIRE SCREENS FOR SIEVES. *O. C. Ellington.* *Journal of the Society of Chemical Industry, 1926, 45, No. 19, 123-124T.* A suitable generally recognized standard system of wire screens does not exist in this country, and a comprehensive system of screening gauzes meeting all the stated requirements is suggested by the author in detail. J. P. O.

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[1] See also *I.S.J.*, 1920, 284. [2] See Recent Patents, *I.S.J.*, 1923, 165 ; 1924, 504 ; 1926, 171.
[3] See *I.S.J.*, 1922, 270 ; 1923, 103; 1924, 502.

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[1] ABDERHALDEN'S "Hand-buch" 1910 edition; vol. 2, p. 139.

[2] *J.S.C.I.*, 1925, 44, 253-258. [3] *I.S.J.*, 1923, 160; 1925, 222.

Review of Recent Patents.[1]

UNITED KINDGOM.

ANIMAL CHARCOAL (BONEBLACK) DRYING KILN. *G. G. Brockway,* of Warren, Pa., U.S.A. *249,381.* July 1st, 1925.

A furnace more particularly adapted for drying boneblack, fullers earth, and like materials comprises a number of shafts *5*, each having projections *16* formed from a single block of refractory material extending from opposite sides, a burner *22* for each shaft, and regulable feeding means. The foundation for the furnace comprises two concrete pliers *1* spanned by a large I-beam *2* and smaller beams *3* on which the furnace structure is built. The beams *3* are spaced apart to take discharge passage blocks *8*, which are formed, as shown in Fig. 5, with projecting parts *9* adapted to fit in the channels of the beams *3*, rabbets *10* for accommodating the webs of cross-beams, and grooves *12* for receiving the bolts. Each block has a tapered discharge passage *14* leading to a restricted discharge opening *15*. The furnace comprises two series of shafts *5* and the projecting blocks *16* are arranged to provide a zig-zag passage for the material and the heating gases. Each block has two inclined faces *17* of the same width as the shaft, a face *18* of substantial thickness at the free end, and end portions *19*, which are built into the lining of the shaft. A hopper *27* supported by angle bars *28* extends above each shaft, and above the feed opening *26* is a feed device consisting of a casing *29*, Fig. 8, secured to the hopper wall by an inclined collar *30*, and a rotatable valve *32*, both casing and valve having openings *31*, *33*, which can be brought more or less into register by turning the arm *34* on the valve. The slot *35* in which the arm works is extended at *39* to the end of the casing so that the valve can be removed when desired. The valves are operated by long control rods *36*.

FIG I

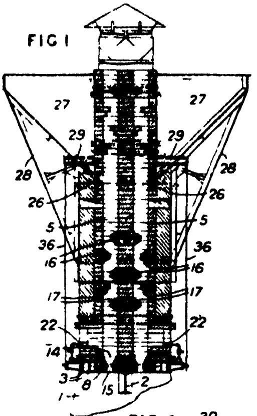
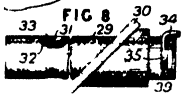


FIG 8



EXTRACTION OF SUGAR FROM MOLASSES, ETC., USING BARIUM COMPOUNDS * *C. Deguide,* of Enghien, Seine-et-Oise, France. *249,759.* October 15th, 1925.

In exhausting molasses, etc., one of the barium silicates $SiO_2.BaO$, or $2SiO_2.3BaO$, is added to precipitate and destroy the impurities, more particularly gums and reducing sugars (glucose and levulose), before precipitation of the saccharate[2] In the example given, the finely divided silicate, mixed with its own weight of water, is added to cane molasses in the proportion of one and a half molecules of baryta to every molecule of reducing sugars present, and the temperature raised to 85°C. After about four hours the impurities are filtered off, and the filtrate is treated with barium hydroxide to give barium saccharate, which is filtered off and decomposed with carbon dioxide to obtain the sugar. The precipitate, which contains unaltered barium silicate, gelatinous silica, organic compounds of barium, and other impurities, may be calcined with barium carbonate to regenerate barium silicate. The silicate employed may be prepared by calcining a mixture of silica and barium carbonate in the necessary proportions, or by decomposing bibarytic silicate, $SiO_2.2BaO$, or a more basic silicate, with hot water as described in Specifications 110,537[3] and 174,052.[4] The precipitate containing the impurities is preferably so regenerated that a more basic silicate is obtained, which can be decomposed by hot water to give the silicate required together with barium hydroxide which may subsequently be used to form the saccharate. The use of more basic barium silicates, e.g., the bibarytic silicate, is also referred to in connexion with cane molasses exhaustion.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom :* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s. each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal (Patents).* with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany :* Patentamt, Berlin, Germany. [2] See also *I.S J.*, 1922, 494, 551; 1924, 442. [3] *I.S.J.*, 1923, 51. [4] *Ibid.*

Beet Topper. *Edwin H. Gratton*, of Bargate, Boston, Lincolnshire. *248,688.* January 8th, 1926.

A device for cutting off the tops of beets comprises a vertical support to the lower end of which is attached a U-shaped strip of sheet metal forming the foot for holding down the root. A knife blade carried at one end of a rod is slidably mounted in bearings which are attached to the said vertical support. The knife rod is held in the withdrawn position by a spring, and when the device is in operation the knife rod is depressed manually so that the knife descends in front of one end of the foot of the bracket and so shears off the head of the root. It will be understood that the foot for holding the root may be of any suitable shape such as semi-circular in cross section and that the knife may have a straight, semi-circular or other shaped edge. Referring to the drawing, *a* is the vertical support having attached thereto the foot *b* which is shown of semi-circular shape in cross section and the brackets *c* and *d* for carrying the knife rod *e*; *f* is the knife blade which is caused to descend vertically against the action of the spring *g* by pressure of the hand on the handle *h* of the rod *e*; *i* is a handle provided on the top of the support *a* for holding the tool in position over the root. As above described, the knife *f* may be operated by treadle, or like mechanism instead of manually, as in the construction illustrated.

Fig.1.

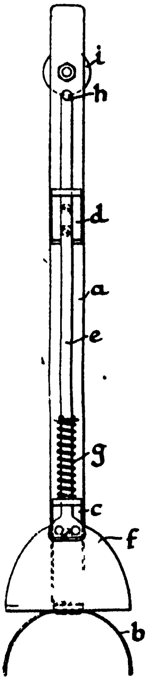
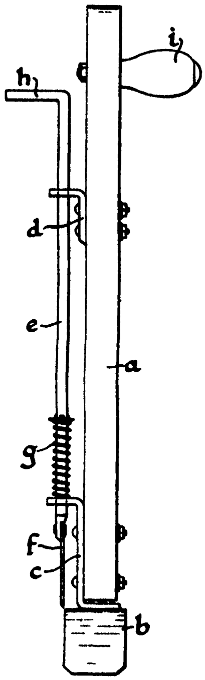


Fig.2.



Alcohol Motor Fuel. (*A*) *O. Leonori*, of Nairni, Italy. *245,460.* December 31st, 1925; convention date, December 31st, 1924. (*B*) *E. M. Flores*, of Buenos Aires, Argentina. *249,577.* October 28th, 1924. (*C*) *G. Patart*, of Paris. *250,563.* March 29th, 1926; convention date, April 9th, 1925.

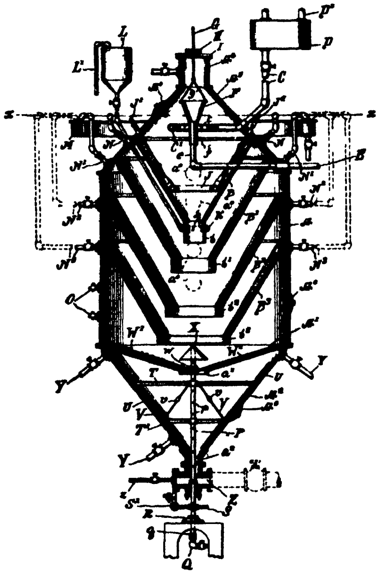
(*A*) Fuel for internal-combustion engines in obtained by treating alcohol with calcium carbide. Hydrocarbons such as petrol, benzine, shale oil, turpentine, benzol, toluol, xylol, amylene, naphtha, and naphthalene may be added before or after the carbide treatment. The alcohol may be pure, methylated, or commercial. The alcohol or hydrocarbons or both may be first purified by agitation with a small quantity of ammonium hydrate which is not separated. A suitable fuel consists of 60 lb. of alcohol, 20 lb. of turpentine, 10 lb. of benzol, 15 lb. of petrol, 2 lb. of naphthalene, and the dissolved acetylene. (*B*) Liquid fuel is obtained by adding carburetting substances to raw fermented musts, and distilling after allowing the mixture to stand. Acetylene or other hydrocarbon gas, and odorizing or colouring substances, may be added. Carburetting substances specified are crude petroleum, the 150-220°C. fraction, benzol, naphthalene, or the like coal products. Prior to distillation there may be added one or more of the following:—(1) a denaturant e.g. phenols from vegetable tar, formaldehyde, acetone, or methyl alcohol; (2) a solution of 10 grms. of boric acid in 100 grms. of methyl or ethyl alcohol, or a mixture; (3) a mixture of 3 parts of methyl alcohol with one part of acetone. (*C*) Products, consisting of a mixture of higher alcohols, ketones, etc., from the catalytic interaction of carbon oxides and hydrogen at elevated temperature, can be used for liquid fuel, rectification being, however, necessary.

Improved Water-Tube Boilers. *Clarke, Chapman & Co., Ltd.*, and *W. A. Woodeson*, of Gateshead-on-Tyne. *248,905*. February 19th, 1925. Water-tube boilers of the kind embodying one or more sections each comprising an upper steam and water drum and a lower water drum connected to each other by transverse double rows of tubes spaced comparatively widely apart, are provided with both bent and straight tubes, the straight tubes being located towards the middle of each row and some of them occupying what would otherwise be spaces between the tubes.—Lactose Manufacture. *A. G. Bloxham* (communicated by *Elektro-Osmose A.-G., Graf Schwerin Ges.*, of Berlin, Germany). *248,998*. July 17th, 1925. Lactose is prepared from whey by neutralizing the whey until it is approximately at the true neutral point, bringing it to a temperature which promotes coagulation of the albumens, acidifying at this temperature, and, after removal of the precipitated albumens, treating the liquid electro-osmotically.—Fermentation Processes, using Yeast Stimulants *J. Van Loon*, of Deventer, Holland. *248,373*. February 23rd, 1926; convention date, February 25th, 1925. In fermentation processes, employed in distilleries, breweries, and the like, the activity of the yeast or other ferment is enhanced by the addition of "per compounds" such as benzoylperoxide, acetyl-benzoyl peroxide, dibenzaldi peroxide, peracetic acid, perbenzoic acid, the salts of organic peroxides, inorganic peroxides or addition compounds of hydrogen peroxide and inorganic salts. Nutritive media such as sulphates or phosphates with or without the addition of innocuous diluents may be added also.—Production of Glutamic Acid and Glutamates. *K. Ikeda*, of Tokyo, Japan. *248,453*. December 3rd, 1924. Glutamic acid and its salts are obtained from *schlempe* (*vinasse* of beet molasses) by hydrolysing it and converting the glutamic acid into its sparingly soluble calcium salt. *Schlempe* liquor may be treated with excess of lime to produce the desired calcium salt in one operation or it may first be hydrolysed with a mineral acid such as hydrochloric or sulphuric acids, and the neutralized solution treated with lime. Alternatively, the *schlempe* is treated with hydrochloric acid and after filtering off humus-like products, crystalline potassium chloride, and betain hydrochloride, the concentrated filtrate is further treated with hydrochloric acid to form glutamic acid hydrochloride, which is dissolved in water and digested with excess of lime.—Materials for Edge Filters. *H. S. Hele-Shaw and J. A. Pickard*, both of London. *249,202*. December 17th, 1924. Paper treated with nitrocellulose, or acetylcellulose, rubber, chlorinated rubber, celluloid, casein, cellulose esters, natural or synthetic resin, hardened gelatine, asphaltum or formaldehyde condensation products, etc., may be used as the material for edge filtration.—Rotary Edge Filter. *H. S. Hele-Shaw; B. Stillman, and J. A. Pickard*, all of London. *249,593*. December 19th, 1924. In a rotary filter, provided with scrapers or brushes moving across the filtering surface, the elements may be edge filtration units consisting of piles of material held together in frames.—Water-Tube Boilers. *Ransomes, Sims and Jefferies, Ltd., and J. A. Garrett*, of Ipswich. *249,333*. April 9th, 1925. Upper and lower drums of a water-tube boiler heated by waste gases, etc., are connected by banks of straight tubes, each bank being arranged in a separate flue or casing 4 and having a partition so that the gases flow up one side of the partition and down the other, and the flues each consisting of a two-part casing, the parts being adapted to be moved apart so as to facilitate the inspection and cleaning of the tubes.

UNITED STATES.

CLARIFIER (SUBSIDING TANK). *Rafael Vachier*, of Baton Rouge, U.S.A. *1,578,221.* March 23rd, 1926.

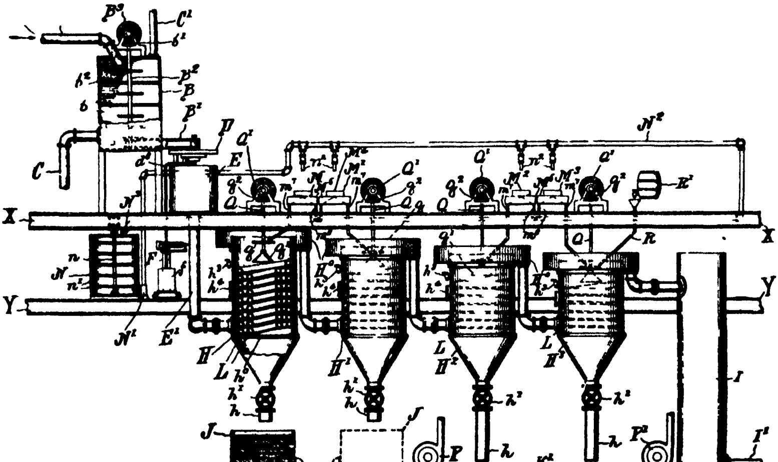
This tank is intended to separate the mud at the bottom and the scum at the top, and to discharge clear liquid. It is provided with an outer shell having the central cylindrical liquid chamber A, with the inner bottom A' in the form of an inverted truncated cone open at its centre as at a'. Below there is another inverted truncated cone, forming with the bottom A' the mud chamber A^2, which is also provided with a central opening a^2 at the bottom. The upper end of the liquid chamber is partly closed by the truncated cone A^3, forming a scum chamber, which is open at the top and terminates in the hollow cylinder A^4. Mounted within the shell are a series of hopper-like baffle cones, B, B', B^2 and B^3, which are secured at their upper edges to the interior of the shell, and are provided at their lower ends with hollow cylindrical ducts b, b', b^2 and b^3. The outer shell is also provided with suitable manholes A^0 for cleaning purposes, and with suitable wash holes a^0, these being ordinarily provided with removable water-tight covers. Raw juice is admitted through the inlet pipe C from the flash tank D, which is supplied with juice from the mills through the pipe D'. This pipe C terminates at its lower end in the circular pipe C', provided with a series of perforations c. The discharge pipe for the scum E has its inner end e projecting upwards in the centre of the ring C', and telescoping over this end e is a sleeve f of the scum-cone F. This is preferably made vertically adjustable, as by the slings g and screw G, which screw engages the handwheel H, which is interiorly screw-threaded to engage screw G and bears upon the beam I, spanning the open top of the cylinder A^4. By turning this handwheel H, the scum-cone may be raised or lowered, as desired, so that the top of said cone may be adjusted to the desired height above the normal level of the juice in the cistern indicated by the line $x-x$. Juice is heated in the upper part of the clarifier by means of the steam coil J fed with heat medium through the pipe J', and the condensed steam and vapour is carried off through the steam trap J^2 to the hot well (not shown). Lime, or other reagents, may be admitted to the partly clear liquid at the bottom of the cone B by means of the annular pipe K, having the nozzles k, which pipe K is supplied with lime or other reagent through the pipe K' from the constant pressure reagent supply tank L, provided with said reagent through the pipe L'. M represents the clear juice trough, which receives its clear juice through the pipes N, N', N^2 and N^3 from the upper end of the V-shaped annular chambers, formed by the baffle cones and the outer shell of the clarifier. The juice is carried off from this clear juice trough for further treatment, as well known in the art. Suitable test cocks O may be provided at any portion of the shell, and preferably in the lower portion thereof, as shown. Journalled in the axis of the mud chamber is provided a hollow rotary shaft P, perforated as at p, to permit the flow of water therefrom, which water is supplied through the pipe Q, connected to the lower end of the hollow shaft P, as by means of the stuffing box q. This shaft P is supported on the anti-friction bearings R. This shaft carries a wormwheel S driven by the worm S', so that the shaft may be given a slow rotary motion. This hollow shaft P carries arms T and T', to which the scrapers



U are connected, adjustment being given to these scrapers by means of the stays *V* and turn buckles *v*. These scrapers *U* rotate inside of the conical mud chamber. Shaft *P* also has clamped or otherwise secured thereon the hub *W*, to which the scrapers *W'* are attached, which rotate above the conical bottom *A'*. The top of the shaft carries a dispersion cone *X*. Water may be supplied through the pipe *Y*, and the mud and water are carried off through the mud pipe *Z*, which may be spread out, if desired through the spray pipe *z*.

SYSTEM FOR THE CLARIFICATION OF CANE JUICE, ETC., BY LIMING *Irving H. Morse*, of New Orleans, La., U S A. *1,573,333*. February 16th, 1926.

In clarification it is difficult with present methods to secure the sufficient admixture of the very small amount of milk-of-lime with the very great bulk of juice to which it is added, the ratio being about 1 to 1000. And admixture must take place instantly, since if there is delay part of the juice becomes alkaline, and glucose is decomposed. Apparatus and procedure for effecting an instantaneous admixture of lime and juice are now described. Raw juice from the mill goes from the pipe *A* into the sulphur box *B*, and is carried off from the sulphur box by the conduit *B'*. In order to finely divide the liquor as it is being treated by the sulphur fumes, a shaft B^2 is provided carrying scattering discs or plates *b*, which shaft is rapidly rotated by the pinion *b'* driven by the gear-wheel B^3, besides which the sulphur box is also provided with the usual perforated baffles b^3.



Juice flows from the conduit *B'* to the sampling box *D*, where a small proportion thereof is separated from the main body, the bulk flowing into the juice tank *E*, then by the pipe *E'* to the first liming tank *H*, overflowing from this into the second liming tank *H'*, and from this to the third liming tank H^2, and from the third to the fourth liming tank H^3, finally flowing into the common defecator charge tank *I*, from which it is carried off by means of the pipe *I'*. Each of the liming tanks is provided with an annular overflow trough H^0, and this trough is placed at a slightly higher elevation than the trough of the next tank in the system, so that there will be a continuous flow from the one tank to the other, the tanks preferably decreasing in size for obvious reasons. Each tank is provided with a heating coil *L*, and the bottom is preferably hopper-shaped, provided with a drain pipe *h*, controlled by the valve *h'*. In the upper portion of the conical bottom chamber or hopper, a baffle plate h^0 to prevent the rotary motion in the liquor in said hopper is provided. *J* represents a car carrying a suitable filtering arrangement, such as burlap bags filled with black Spanish moss, through which the liquid portion of the sediment passes, leaving the sticky portions adhering to the bags and to the moss. *K* represents a tank for the reception of the wax-free liquid from the first liming tank, or the first two liming tanks, and *K* represents a tank for the sediment from the second pair of liming tanks. Milk-of-lime is supplied to the tanks from the boxes M, M', M^2 and M^3, from the tank *N*, where the lime is held in suspension by the rotation of the shaft *n*, carrying arms or discs n'. This milk is conveyed to the lime supply pipe N^2, and the requisite quantity is supplied to each tank from the nozzles n^2, controlled by suitable valves, the excess of lime being carried back to the tank *N* by the return pipe N^3. Each liming box comprises an upper receptacle M^4 provided with a series of nozzles, and is slidably mounted on the lower box M^5. The lower box M^5 is provided with a deflecting partition in the form of an inverted V, which is provided at each side of m^6 and below these screens are pockets drained by pipes m^7 and m^8 respectively. The pipe m^7 leads to the liming tank, while the pipe m^8, which carries off the excess lime, is connected to the return pipe N^3 for returning the excess milk back to the large reservoir *N*. In order to distribute the milk which flows to the liming tanks in a finely-divided manner, the outlets of the pipes m^7 are mounted above rotating discs *q* on the shaft *Q*, which shaft carries the cone q' and is driven by the pinion q^2 meshing with the gear-wheel Q'. There is one shaft *Q* for each liming tank and these shafts are driven at high speed with the following result.[1] First, the cones q' throw the liquor from the liming tank away from the centre of the tank towards the circumference, causing it to overflow into the annular trough H^0 in a thin layer, and into this the milk is thrown in the form of a spray under the centrifugal action of the rotating disc *q*. Thus this fine spray of milk is uniformly fed to the thin layer of liquid, resulting in complete and thorough commingling, and causing the entire mass, and practically every individual drop thereof, to be subjected to the action of the lime as it flows over the edge of the liming tank It is preferable to use a major portion of the lime in treating the juice as it flows from the first tank. Thus, in treating the raw juice, use about 60 per cent. of the lime in the first tank, 25 per cent. in the second tank, 10 per cent. in the third tank and 5 per cent. in the fourth tank. After the juice, partly limed and having the larger portion of the sediment separated therefrom, overflows from the first tank, it passes by gravity into the lower portion of the second tank, where the sediment may be again drawn off and passed through filters of any suitable kind, the main body of the juice flowing gently upwards in the second tank and being whirled around the upper portion of the said tank and treated with lime in lesser quantity. Juice overflowing from the second tank flows into the third tank, where the process of sedimentation and further liming, but with a lesser amount of lime, is repeated, and finally this juice overflows the third tank and enters the fourth or last tank, where the sedimentation process is again repeated and the overflow juice escapes into the defecator charge tank. In this last tank, a small quantity of lime may be added; or this may be supplemented by, or preferably replaced by, a small quantity of dilute phosphoric acid from the receptacle R', which passes through the pipe *R* on to the rotating disc and is thoroughly mixed with the overflowing liquor from the last tank; as with lime solution. It will be seen that the operator has complete control at all times of the liming process. If phenolphthalein is used as an indicator, and 10 c.c. of the juice titrated against a N/10 alkali solution, the acidity of the sulphured juice is 4 per cent. and the neutral point 0·5 per cent., then the acidity of the juice in tank 2 should be 1·9 per cent., tank 3, 0·85 per cent. and tank 4, 0·5 per cent. If there are any variations in these gradually decreasing acidities, he can increase or decrease the flow of lime into each tank until the normal conditions are secured. In fact, the chief virtue of the apparatus is the control obtained of the liming and heating during the period it requires the juice to flow from the sulphur station to the defecator charge tank.

Juice Extraction from Beets, etc. *Philip A. Singer*, of Glen Ellyn, Illinois, U.S.A. *1,566,623*. December 22nd, 1925. This patent provides for the combination of a vertically disposed treating receptacle, means for continuously feeding material to be treated into the upper portion of it, and means for continuously withdrawing treated product from the lower end of it. Further, for introducing treating liquid into the receptacle, for inducing a partial vacuum in the upper portion of it, and for discharging such liquid.—Sterilizing and Clarifying Fruit Juices (as Cane Juice). ***William McComb and Wilbert A. Heyman***, of Havana, Cuba. *1,573,177*. February 16th, 1926. Liquid is forced through a zone heated to at least 145°F. (60·3°C.), under a pressure of at least 200 lbs. to the sq. in., then admitting the liquid into a zone heated to a temperature of not over 70°F. (20·1°C.), and simultaneously reducing the pressure thereon to a pressure not exceeding 25 lbs., and then finally introducing said liquid into a zone having a temperature not exceeding 36°F., while reducing the pressure upon said liquid to not more than atmospheric pressure.—Juice Extraction from Beets, etc ***A. Olier***, of Clermont, Ferrand, France[1] *1,555,432*. September 29th, 1925. Claim 1 :—An apparatus for the continuous extraction of sugar from raw material and for like purposes embodying a sinuous fluid-tight conduit comprising a high vertical tube, a number of lower vertical tubes and bends for connecting said tubes in series, an inlet conduit at the upper part of the high vertical tube for supplying the treating liquid, an outlet orifice for exhausting the juice at the upper part of the last lower vertical tube, means for feeding the material to be treated into the top of said last lower vertical tube, a return tube connecting the upper part of said last lower vertical tube to the high vertical tube, wheels disposed in the bends of the sinuous conduit, an endless conveyor passing over said wheels and means for actuating said conveyor.—Cane Cutting Machine. ***Umejire Hirai***, of Honolulu, T.H. *1,559,429*. October 27th, 1925. This machine is arranged to work at one side of its path of movement, so as to cut cane, some of the stalks of which lie on the ground and the remainder extend upwardly. For details of the complicated mechanism the original specification should be consulted.—Automatic Density Control Apparatus for Evaporators, etc. ***Emile F. Salich***, of Chicago, Ill., U.S.A. *1,575,643*. February 23rd, 1926. This comprises means for pumping syrup from an evaporator (or other liquid from other vessel) into a balanced receptacle, which, when in an unbalanced position, operates certain mechanism (here described in detail) to automatically regulate the flow of the syrup for changing the density of the bulk of syrup in the evaporator (or other vessel).—Leaf Filter for Sugar Liquids. ***Werner Hoehn***, of New Orleans, La., U.S.A. *1,564,351*. December 8th, 1925. An open tank contains a series of filter-leaves, which are supported by "holders" extending alongside one side of the tank, which holders are removably supported on the tank, the arrangement of the parts being such that a filter-leaf and holder may be removed from the tank without interrupting the operation of the apparatus. A manifold is provided, also valve controls for independently connecting each of the holders to it.—Production of a Jelly Base. ***Aage Gusmer***, of Newark, N.J., U.S.A. *1,580,665*. April 13th, 1926. Claim :—In the art of jelly making, that step which consists in adding to a pectose extract obtained from vegetable pulp, a fungus possessing both diastatic and fermenting properties active in slightly acid media to convert the starch and albumen constituents of the extract into modified forms and prevent precipitation thereof.—Manufacture of Dehydrated Lime. ***Charles I. Chubbeck*** of San Francisco, Cal., U.S.A. *1,580,710*. April 13th, 1926. Claim is made for a method of manufacturing hydrated lime, which consists in slaking quick-lime in an excess of water to a flowing putty, removing the major portion of the water before the slaking operation is completed, then completing the slaking operation with the remaining water, and utilizing the heat generated by the last slaking operation to evaporate the excess of water.—Manufacture of Yeast from Steffen Waste Water. ***Henry W. Dahlberg***, of Denver, Colo., U.S.A. *1,580,999-1,581,000*. April 13th, 1926.. A process for making yeast with waste-water, the steps of which consist in making bakers' yeast with the use of waste-water as a yeast nutrient, and following this in adding to a mash which is deficient in yeast food, and as a yeast nutrient therefor, the waste-water resulting from the de-sugarizing of beet molasses when sugar is removed therefrom as an alkaline earth metal saccharate by addition of an alkaline earth metal compound, adding yeast, and maintaining conditions conducive to yeast propagation.

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[1] See also U. S. P., 1,311,831; *I.S.J.*, 1919, 585.

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[1] See *I.S.J.*, 1923, 51, 665 ; 1925, 22.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending June 30th.		Six Months ending June 30th.	
Unrefined Sugars.	1925. Tons.	1926. Tons.	1925. Tons.	1926. Tons.
Poland	....	1,633	9,016	12,984
Germany	64	2,860	1,962	4,893
Netherlands	....	....	....	....
France	....	. ..	....	....
Czecho-Slovakia	203	341	1,030	341
Java	1	....	1,863	...
Philippine Islands	...	....	....	....
Cuba	67,999	20,587	396,902	124,195
Dutch Guiana	....	....	....	....
Hayti and San Domingo	19,775	18,884	102,543	69,996
Mexico	....	....	....	....
Peru	309	6,428	36,969	51,034
Brazil	....	....	6,540	95
Mauritius	1,656	8,573	12,788	148,417
British India	....	....	....	....
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	19,699	11,379	81,514	57,739
Other Countries	1,531	4,568	42,614	151,828
Total Raw Sugars	**111,237**	**75,253**	**693,743**	**621,523**
Refined Sugars.				
Poland	10	2,321	13,284	8,454
Germany	282	565	5,946	7,650
Netherlands	11,260	15,224	90,537	104,516
Belgium	1,585	1,191	10,441	6,571
France	....	....	....	....
Czecho-Slovakia	13,728	42,333	119,624	168,964
Java	....	....	....	....
United States of America	23,521	1,623	45,995	6,542
Canada	15,500	9,431	52,326	36,366
Other Countries	.	33	1,525	8,007
Total Refined Sugars	**65,887**	**72,721**	**339,679**	**347,071**
Molasses	30,076	15,781	112,749	81,487
Total Imports	**207,200**	**163,755**	**1,146,171**	**1,050,081**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	Tons.	Tons.
Denmark	101	158	570	677
Netherlands	9	48	85	209
Irish Free State	4,107	3,795	24,639	28,284
Channel Islands	62	67	414	373
Canada	....	...	....	....
Other Countries	1,810	1,128	5,375	19,519
	6,088	5,197	31,083	49,062
Foreign & Colonial Sugars				
Refined and Candy	138	155	747	968
Unrefined	69	80	326	782
Various Mixed in Bond	....	....	....	....
Molasses	19	79	214	1,774
Total Exports	**6,314**	**5,511**	**32,370**	**52,586**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1926. Tons.	1925. Tons.
Total Receipts, January 1st to June 30th	1,959,753	2,012,878
Deliveries ,, ,,	1,746,515	1,878,555
Meltings by Refiners ,, ,,	1,651,000	1,750,330
Exports of Refined ,, ,,	54,000	118,000
Importers' Stocks, June 30th	221,894	134,323
Total Stocks, June 30th	376,687	271,305
	1925.	1924.
Total Consumption for twelve months	5,510,060	4,854,479

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924 Tons.	1925 Tons	1926 Tons.
Exports	2,231,001	2,602,086	2,079,391
Stocks	929,239	1,290,663	1,442,232
	3,160,240	3,892,749	3,521,623
Local Consumption	50,000	72,000	55,000
Receipts at Ports to May 31st	3,210,240	3,964,749	3,576,623

Havana, May 31st, 1926

J. GUMA.—L. MEJER

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR SIX MONTHS ENDING JUNE 30TH, 1924, 1925, AND 1926.

	IMPORTS.		
	1924. Tons.	1925. Tons.	1926. Tons.
Refined	313,901	339,679	347,071
Raw	678,934	693,743	621,523
Molasses	103,622	112,749	81,487
	1,096,457	1,146,171	1,050,081

	EXPORTS (Foreign).		
	1924. Tons.	1925 Tons.	1926. Tons.
Refined	671	747	968
Raw	4,985	326	782
Molasses	1,230	214	1,774
		1,287	3,524

	HOME CONSUMPTION.		
	1924. Tons.	1925. Tons.	1926 Tons.
Refined	263,911	352,239	296,020
Refined (in Bond) in the United Kingdom	460,030	408,024	431,886
Raw	49,863	44,524	79,543
Total of Sugar	773,804	804,787	807 449
Molasses	3,711	3,673	2,918
Molasses, manufactured (in Bond) in United Kingdom	29,614	29,485	32,642
	807,129	837,945	843,009

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT MARCH 31ST, 1926.

	1924. Tons	1925. Tons.	1926. Tons.
Refined in Bond	46,550	39,700	59,300
Foreign Refined	69,850	20,200	161,900
,, Unrefined	189,200	290,750	234,100
	305,600	350,650	455,300

United Kingdom Monthly Sugar Report.

Our last report was dated the 8th June, 1926.

The market generally during the last month has remained steady, prices undergoing little change, although the coal strike is having a detrimental effect on the distribution of sugar. The Refiners and manufacturers alike have experienced great difficulty in obtaining coal and the very large number of unemployed—caused directly and indirectly by the dispute—has affected the consumption adversely.

The London Terminal Market has remained quiet during the period under review and it is only during the last week that transactions became in such large volume as formerly. Only a few thousand tons were tendered in June and this month was finally liquidated at about 14s. A good business was done in August from 14s. 6¾d. to 13s. 11¼d. to 14s. 4½d. to 14s. 0¾d., and this month is being gradually transferred to forward deliveries. October sold from 14s. 9d. to 14s. 4½d. to 14s. 9d. to 14s. 5¼d., whilst December sold from 15s. to 14s. 7½d. to 15s. 1½d. to 14s. 9¾d. March was sold from 15s. 3¾d. to 15s. to 15s. 6d. to 15s. 2¼d., and May from 15s. 6¾d. to 15s. 3¾d. to 15s. 9¾d. to 15s. 6d. The latest prices are August 14s. 0¾d., December 14s. 9¾d., March 15s. 2¼d. and May 15s. 6d.

Trading in actual sugars has been slow and the demand has not been good. There is no pressure to sell from the Continent and the Czecho Refiners do not appear to have much left for sale. Ready Czecho Granulated has not been too plentiful and has been sold from 14s 7½d. to 14s. 9d., whilst July and August sold at 14s. 9d to 14s. 10½d. Dutch Granulated has generally been sold for a premium over Czecho sugars. The value of American Granulated has been 15s. 7½d. c.i.f. but practically no business has transpired. White Javas for May/June shipment are not offering in parity with U.K. prices. Spot Granulated in London sold from 27s. 7½d. to 27s 1½d. to 27s. 4½d. duty paid.

The British Refiners have done a fair business. On June 15th they reduced their prices by 6d. per cwt., but at this level a bigger demand set in and the next day their prices were advanced by 3d. per cwt. Again on the 30th June a further 3d. per cwt. advance was registered. The latest prices are No. 1 Cubes 33s. 3d., London Granulated 29s. 1½d. duty paid.

The British Refiners have not been large buyers of raws in consequence of the large stocks and the depression caused by the coal strike. Business, however, was done in Cubans at 11s. 6d. to 11s. 10½d. c.i.f. Several cargoes were also sold to the Continent at these prices. Owing to the coal position freights have been advanced by 7s., or 8s., per ton which is, of course, reflected in the price of c.i.f. raws.

In New York a fairly large business has been done to the American Refiners, who have been larger buyers than formerly owing to an improved refined demand from the trade. Cubans were sold from 2⅜ to 2$\frac{7}{16}$th, and Porto Ricos and Philippines for 4·18 to 4·21 c.i.f.

The Futures Market fluctuated only slightly but speculators have been principally interested in transferring July to forward months and the turnover recently has been abnormally large.

The Cuban production to date is given as 4,879,000 tons against last year 5,018,000 tons on the same date, and it is now generally agreed that the final production will not exceed 4,900,000 tons, which will be over 200,000 tons less than last year. Stocks at the ports to date are given as 1,327,592 tons against 1,094,796 last year.

The only change F. O. Licht has made in his estimate of the European sowings has been to reduce Russia, but this was already anticipated.

An important feature recently has been the extraordinarily wet weather experienced this summer in Europe. The rivers have been so high that navigation has been interfered with. It is reported that owing to the unprecedented weather, the crop in Czecho Slovakia has suffered material damage, but this can only be proved by the final outturn.

21, Mincing Lane,
London, E.C. 3.
July 9th, 1926.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE
INTERNATIONAL
SUGAR JOURNAL.

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No. 332. AUGUST, 1926. Vol. XXVIII.

Notes and Comments.

The Anglo-Ceylon & General Estates Report.

The annual report of the Anglo-Ceylon & General Estates Co., Ltd., which has just recently been issued is of interest in more than one respect. It reveals the advantages in a tropical producing company of having several varieties of staple crop so as to average the gains and losses of what is bound to be a somewhat speculative business; and it shows in respect to its sugar production the unremunerative nature of an industry where the price has been lowered through world over-production to an uneconomic level.

This Company is interested principally in tea and rubber production in Ceylon, and sugar production in Mauritius. For the year ended last March the net profit on the trading and profit and loss account was £110,107, as compared with £81,469 the previous year; but while the Ceylon income showed a surplus over expenditure of £116,784, chiefly owing to a much better price for rubber, the Mauritius sugar crop resulted in a loss. The Mauritius figures for the past two years have been: 1924-25, Expenditure £193,320, Income £183,653, net loss £9667; 1925-26, Expenditure £162,296, Income £144,574, net loss £17,721. The profit of the Company was further increased by dividends on investments, so that in spite of the loss on the sugar properties, a dividend for the year was declared of 20 per cent. as compared with 15 per cent. the previous year.

The Chairman (Sir EDWARD ROSLING) at the annual meeting said that Mauritius had again proved a disappointment for them, for although very considerable economies had been effected in management, the low price for sugar prevented any profit being earned. Including bought canes, 144,328 tons, as compared with 130,182 tons in 1924-25, were dealt with by the estates, producing a crop of 14,777 tons, as compared with 13,537 tons. The prospects for the current year show a slight improvement in that prices are fractionally better than the average obtained for last season's crop, and costs show a further reduction. Part of the Riche Bois estate adjoining the company's Britannia estate has been purchased, adding some 20,000 tons of cane to the supply available for the Britannia factory, which should be of assistance in further reducing costs. The coming crop is expected to yield rather over 16,000 tons of sugar; in May a hurricane passing near the island did some damage to the young canes, but since then exceptionally favourable weather has to a certain extent counteracted the ill effects of the storm. Sugar, Sir EDWARD ROSLING added, is always rather a speculation, but it must not be forgotten that in the 1920-21 season (when their Ceylon interests resulted in a loss of £16,000) Mauritius left a profit of over £300,000 and although they did not expect ever to see such a profit repeated, they expected over a series of years quite satisfactory returns from their sugar investments.

The Uneconomic Price of Sugar.

This company is probably typical of British colonial sugar producing companies in general; efficiently managed, but with an output on a decidedly small scale, especially when compared with the huge outputs of American, Cuban and Javanese factories. Even with the aid of the preference on entry into the United Kingdom it is unable at present day prices to make a profit on the sugar produced. This is not to be wondered at when even the big New World factories are finding the current price no longer remunerative, and Cuba has led a bold and, let us hope, not futile attempt to restrict production to a more reasonable ratio to consumption. But in the competition amongst world producers of sugar, the huge corporations, especially those situated on the Cuban seaboard, have a decided pull over the smaller fry with their ten or twenty thousands of tons annual production; and the British West Indies for one are pressing for an increased preference to meet this formidable competition. If these corporations can continue to produce sugar at a profit at the present low prices, they will assuredly do so; but they are using up their raw material at a rapid rate and the time cannot be far off when their lands will cease to produce on the present scale without a considerable expenditure in fertilizers for replenishing them. It is probable, therefore, that they will themselves realize the advantage of securing a more remunerative price for the sugar, and will accordingly take steps to restrict the increase in production that has been such a feature of the sugar world the last few years. As it is, the slowing down is already apparent in respect to the 1924-25 and 1925-26 seasons, for while the former had an increase in production of three and a half million tons of sugar, the latter is estimated to have one of no more than two-thirds of a million. What estimates are already available of the 1926-27 crop tend on the whole to show a reduction in output for next year. These include Cuba, Argentina, Java, Australia and Mauritius. It may therefore be concluded that a halt is being called in increased production, if not an actual reduction of output, and prices will have an upward tendency before very long which should result in a more economic price for the new crop sugar. The improvement may not be marked at first, but it is difficult not to believe that the tide has turned and that sugar will once more become a paying tropical product, even if it cannot attain the profits that seem assured to tea and rubber for some years to come.

The United States Consumption, 1926.

Messrs. WILLETT & GRAY have just compiled what they call the indicated consumption of sugar in the United States for the first six months of 1926. This they consider somewhat disappointing in that the figures show a decrease from the amount consumed during the corresponding period of 1925; but it has been known in the trade that sugar consumption in general has been suffering from the prevailing cool weather of the spring and early summer. The figures are: Consumption in first six months of 1926, 2,925,254 long tons; in 1925, 3,017,282 tons; in 1924, 2,680,950 tons. The decrease in 1926 as compared with 1925 is therefore 92,028 tons, or 3·05 per cent. But considering the adverse weather conditions the 1926 figure is, generally speaking, a very favourable showing when contrasted with 1925, a year which yielded the largest half-year's consumption ever experienced in the United States.

Based on these figures another American statistical firm attempts to estimate the probable consumption for the whole of 1926. Taking the average of the past ten years, the second six-month periods show a decrease over the first six of some 16 per cent., which would indicate for 1926 (second half) a consumption of 2,460,000 tons, giving a total for the year of 5,385,000 tons, which compares with 5,510,060 tons for 1925, a decrease of some 125,000 tons. Even this, however, is easily the next best figure of the last ten years. But it is observed that the present refiners' stocks of unconsumed refined sugar are known to be very large, and these being included in the estimated consumption for the first six months, it is possible they will have an influence on the consumption figures in the second half, so that the 1926 total may be less than above indicated.

Disposing of the Cuban Crop.

News from various sources in New York sugar circles suggests that the attempts of Cuba to so dispose of her sugar crop as to force up the price of sugar to a more economic level are meeting with criticism. According to the *Federal Reporter*, it is stated that the President of Cuba has under consideration a plan to consign half a million tons of Cuban sugar to the Far East at a very low price for consumption there. This scheme, if carried out, is of course calculated to advance prices of sugar for the United States, and the adoption of any such methods of exacting higher prices from U.S. buyers is hardly consistent, it is argued, with the recent Cuban propaganda for an increase in the preference accorded Cuba in the U.S. tariff. In fact, it is asked why Cuba should be allowed indefinitely to receive this preference under the existing treaty of reciprocity. The desirability in the above circumstances to give a year's notice of abrogation of the treaty is even hinted at. The American market would seemingly not accept lying down a policy of giving a preference to Cuba, while Cuba arranges to give sugar practically away to people who have never been her customers and who probably never will be, in order to make the American consumers pay more for their sugar. American interests apart, the invasion by Cuba of the Eastern market would affect the interests also of India, Mauritius, Java and Japan, who are all concerned in that quarter. All things considered, the disposal of the excess Cuban production is a thorny problem, and one wonders whether the somewhat fantastic proposal of some years ago to dump the excess into the sea would not tread on fewer corns in the sugar world than would the proposal to sell sugar in a rival market at a still more uneconomic price than rules at the present day.

Aeroplane Control of Insect Pests.

About a year ago[1] we referred to interesting experiments that had been carried out in the Philippines to use aeroplanes as a vehicle for spreading poison dust over crops to combat the locust menace in those islands; these had led to the conclusion that the aeroplane furnishes the surest and quickest means for observation, communication, and transportation of nearly everything needed for a locust campaign, the most effective method of driving locust swarms, and a convenient means for spreading calcium arsenate dust over the crops affected by the hoppers.

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[1] *I.S.J.*, 1925, 291.

In the June number of the *Journal of the Ministry of Agriculture* the use of aeroplanes for applying insecticides is described and discussed by Dr. A. D. Imms of Rothamsted Experimental Station, he having last year paid a visit to the experiment station at Tallulah, Louisiana, the centre of the cotton district, and witnessed demonstration flights for dusting purposes by aeroplanes there. We collate the following particulars from his interesting paper.

Aeroplane experiments for the application of insecticides were first investigated in 1921 when the Ohio State Experiment station carried out trials with lead arsenate over groves of catalpa trees that were being defoliated by the larvae of the catalpa sphinx moth; and the success achieved led to similar trials being planned to combat the cotton boll weevil. Meanwhile, the following year, experiments were carried out at Tallulah to deal with the cotton leaf worm which was causing severe damage in the vicinity; this being a leaf-feeding insect, it lent itself more easily to preliminary experimenting, and the results showed that the worm could be controlled with a poison allowance considerably below that necessary with ordinary ground dusting machines. In 1923 experiments were undertaken on boll weevil infestations and showed that the aeroplane can distribute an insecticide efficiently, effectively and profitably; in 1925 some 50,000 acres of cotton were dusted commercially; and plans are in preparation for a more extended application of this aerial dusting. The advantages have now definitely passed the preliminary experimental stage, and spruce, pecan, tobacco, peaches, citrus fruits, as well as catalpa and cotton, have been successfully dusted from the air. Experiments also in poisoning mosquito larvae with paris green delivered by aeroplanes in the lakes and bayous of Louisiana have met with success. Likewise has the control of mosquito larvae in flooded rice fields.

In so far as cotton dusting is concerned, the aeroplanes fly from 10 to 20 ft. above the growing crop at a speed of 60 to over 80 or more miles an hour. Under ordinary conditions it is not necessary to distribute more than 2 to 3 lbs. of the arsenical mixture per acre in order to obtain satisfactory weevil control. At first military aeroplanes were tried, but were not found suitable enough; and the aeroplane builders soon turned out special planes to Departmental specifications capable of short flights involving quick turns in restricted areas. Two patterns are referred to: one, the Huff-Daland Model 5, is of diminutive size, while possessing good manœuvring capacity and ease of control. It can carry a load of 300 lbs. of calcium arsenate, sufficient fuel and oil for a 4-hours' flight, and is capable of dusting 300 to 400 acres per hour. A larger model, No. 31, for dusting large open areas, can carry 1000 lbs. of poison powder, fuel and oil for four hours, and can dust 600 to 1000 acres per hour; 80 per cent. of the cotton fields can by done by means of smaller machines, and at an average of 350 acres per hour, a day's flight of four hours will be capable of treating 1440 acres.

The advantages accruing from aeroplane dusting are stated by the American experts to include: (1) It saves 50 to 60 per cent. of the arsenate required to produce the same results by any other method of dusting; (2) unlike ground dusting it need not be carried out at night; (3) one aeroplane will carry out the work of 50 to 75 cart dusting machines, since the best cart machine under favourable conditions dusts only 30 acres a day. According to figures compiled by the Louisiana State University, in 1924, the average cost of five dustings was only $7·26 per acre, and the dusted fields yielded an average clear net gain of $33·14 per acre (at 11 cents per lb. of seed cotton) over fields that were not dusted.

One interesting and remarkable fact about this aeroplane dusting is the large amount of poison that adheres to the plants over a very wide path, and even under atmospheric conditions that would be considered impossible for adherence to occur with the use of the best of existing ground dusting machines. It appears probable that a considerable portion of the observed effect is due to the positive electric charging of the particles of the dust and their coming into contact with plants which carry a negative charge. The scientific principles involved hereby and their possible application are being further investigated.

Work of the Sugar Section of the B.E.P.O.

The work of the Sugar Section of the British Empire Producers' Organization for the year ended last April is recorded in the annual report recently published. The stabilization of the sugar preference, for which the Section had worked, came just in time to maintain production in various parts of the Empire, which, owing to the depression in the sugar market, would not otherwise have been possible. It is felt that if Empire sugar is to maintain itself in world competition, it will be necessary to obtain free import into the United Kingdom, virtually the only large market open to it, and for this the organization is pressing.

Proposals to create a Sugar Federation are making headway, and a draft constitution is under consideration by a committee. The following is the list of objects with which it is intended to be concerned:—(*a*) To increase and improve the production of sugar in the British Empire. (*b*) To secure for the producers preferential terms in all Empire markets, having in view the very favourable treatment accorded by foreign countries to their national or colonial producers, and to arrange that wherever possible such terms shall take the form of money value preferences in import duties stabilized for a period of years. (*c*) To act as an enquiry bureau in regard to all matters affecting sugar, and to keep its constituent members in touch with the latest imformation—scientific, industrial and economic—and to advise them when required in regard to markets and marketing methods. (*d*) To promote for the benefits of its members research in the growing and manufacture of sugar, and the study of the scientific production and industrial application of sugar by-products of all kinds. (*e*) To make such arrangements as to marketing as may advantage the industry as a whole, in this behalf to come to agreement with the sugar-using industries or any section of them. (*f*) To arrange for the thorough understanding of Empire sugar questions by as large a number as possible of the members of Legislatures, both in Great Britain and in the Empire overseas. (*g*) To arrange publicity and propaganda to stimulate the public demand for Empire-grown sugar.

Representations have been made during the year to the Government in regard to the preparation and issue of official sugar returns, and the operation of the payment of drawbacks upon the export of sugar manufactured, which at present tend to check the sale of Empire sugars to confectioners.

Economics of Sugar Beet Cultivation in Holland.

A questionnaire on the cultivation of sugar beet was recently distributed in the northern counties of Holland and replied to by 26 growers in Groningen, 27 in Friesland, and 3 in other districts.

The question as to whether the soil should be periodically allowed to lie fallow has been unanimously answered in the negative. The answer to the question regarding the influence of the cultivation of beets on the soil is that provided the ground is kept well weeded the influence is very good. The question whether growers intend to continue growing beet and whether it is a good alternative crop has been answered in the affirmative. The answer to the question whether the beet tops were equivalent in value to the wages paid was not unanimous; 18 replies estimated the value higher, 25 lower, and the remainder stated it depended on local circumstances.

The cost of raising a wheat crop (seed, fertilizer, preparing the soil, weeding, sowing, transporting, threshing, pressing), amounted to fl. 256·62½ per hectare in Friesland and fl. 279·91 in Groningen, the difference being due to the greater use of fertilizer in Groningen than in Friesland; the production of wheat averaging 3405 kg. per hectare in Friesland and 3609 kg. in Groningen. The cost of raising a beet crop (fertilizers, preparing the soil, weeding, collecting—lifting, transporting, siloing, etc.) in Friesland amounted to fl. 387·89½ per hectare against fl. 389·39½ in Groningen. Again, there was a considerable difference in the cost of fertilizers in Friesland and Groningen, being fl. 64·80 and fl. 85·84 per hectare, respectively; the production of beet in Friesland being on an average 31,900 kg. and in Groningen 33,000 kg. per hectare. Groningen concentrates more on production of seed grain, and the straw prices there are better owing to the close contiguity of strawboard works. Apparently the increased use of fertilizers is of great influence on the formation of the tops, of which the value is estimated at fl. 175 per hectare, against that of straw at fl. 135 per hectare. In calculating the cost, the work of one horse per hour was fixed at 50 cents, the hourly wages of a labourer at 30 cents, and the distance from the farm to the quay or station 1 kilometre.

The conclusion reached is that notwithstanding the higher cost of production, the value of the product, provided the sugar market remains at the present level, will warrant the continuation of beet growing. The sources of information from which the above data have been taken elicit the fact that the greatest amount of labour in growing beet is required at a time when other crops do not call for much attention, and therefore forms a link in keeping labour employed during the whole year. It is stated that every farmer can put up to 15 per cent. of his arable soil under beet and employ his own personnel solely for its attention with the exception of weeding.[1]

Early Conditions of the 1926 Beet Cultivation in Italy.

The bulk of the beet sowings in Italy this year had a quite favourable weather accompaniment. Weeks of dryness and cold followed, however, that were not favourable to germination and to growing in general. In the preliminary period (that stretched from the end of February to the middle of March) in which was sown about two-thirds of the entire acreage destined to beetroot, the results were the least favourable. But germination was better than anticipated. The sowings in the second period (from end of March to end of April) met with better success. For these reasons germination taken as a whole was this year quite satisfactory. What was not satisfactory was the development of the small plants. Through the continual low temperatures of April and May this took place very slowly. The frequency of the rainy days in the second half of April and in the first two decades of May restricted all cultivation. This culminated towards the middle of May in torrential rains which inundated certain localities, submerging some hundreds of hectares of beet cultivations.

So all things considered the Italian beet crop this year, like others on the Continent, has had a far from favourable start. As at present anticipated the acreage that will be cultivated with beets will vary between 80,000 and 82,000 hectares.

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[1] D.O.T. Report on Industrial Conditions of the Netherlands.

Fifty Years Ago.

From the "Sugar Cane," August, 1876.

In this issue of our predecessor an account was given of a very interesting and practical process of treating the syrups and molasses obtained in sugar factories and refineries, namely, that known as the "alum process" for the recovery of potash, patented by JAMES DUNCAN and the BROTHERS NEWLANDS. It consisted in the addition of aluminium sulphate in order to form potash alum, which crystallized out of the liquors at a certain density and temperature. It was an attractive process, since, not only was the molasses purified by being rid of a strongly melassigenic base, but the potash was obtained in a form which at that time had a good market value. Later, however, the price of potash alum fell, and the process became no longer remunerative, but this did not happen for some years, during which several refineries in the United Kingdom, France, Holland, and America adopted the alum process with very satisfactory results.

Precipitation was accomplished by adding to the cold syrup a sufficient amount of aluminium sulphate to precipitate all the potash, the density of the liquor being 38° Bé., and that of the aluminium solution about the same. After stirring the mixture for about 30 mins., it was allowed to rest for 4–5 hours until the deposit, technically termed "alum meal," had completely subsided. Then the clear acid liquor was run off into another tank, where it was treated with lime in order to precipitate any excess of aluminium salt, after which it was passed through Taylor bag filters, and subjected to the usual routine of the refinery. As for the alum, this was centrifuged and washed, pugged with a little water, and again spun, this giving a salt which was white, free from sugar, and suitable for the market.

Applied to Lavenham beet syrup, the process showed a diminution of the ash from 8·52 to 1·66 per cent. of the dry matter; while in a French factory a second molasses showed a decrease of the ash from 16·42 to 11·35 per cent. on the same basis. Besides eliminating the potash (and ammonia also, though generally this second constituent was small) a good deal of the colouring matter and albuminoids were removed as well. Little extra plant was required, and the process was of a continuous and rapid character. It was operated at the Clyde Wharf Refinery, London, with the production of several hundred tons annually of potash of good quality, which was sold at a fair market price.

Another article by W. EATHORNE GILL in this number was concerned with the shortcomings of the method of making sugar at that day, the following being some extracts: "The great desideratum sought for is that means to clarify cane juice of all its impurities without adding chemicals to involve the process in another expense in getting rid of those chemicals. The so-called clarification by sulphurous acid and lime does whiten the sugar . . . . and that other discovery of merely inverting the order of procedure by adding the lime first to saturate the sugar and then precipitate the lime by sulphurous acid gas. . . . The cane juice is now 'clarified,' as if those gummy matters also fell down. On the contrary they remain dissolved in the cane juice, and deceive the observer, for they are so dissolved by the lime as to remain undistinguishable by the eye. That they have not been removed by subsidence is clear from the fact that they unfortunately reappear now loaded with sugar as molasses to the immense loss of the planter. . . . ."

Sugar Cane Diseases in Mauritius.[1]

This bulletin is of a popular character, and is drawn up for the information of the planting community; but, at the present juncture, it is of special value to all students of cane diseases, just to know what forms occur in each country, and to what extent they are of importance. As the author states, Mauritius is singularly fortunate as regards fungus diseases in its cane fields. Such dangerous kinds as Fiji, sereh, mosaic are unknown, and no general epidemics have occurred in recent years, as has been the case with so many countries. This fact is somewhat remarkable, when we consider the great interchange of cane varieties which has all along been characteristic of Mauritius, and the absence of all restrictions prior to 1910, and also the absence of the practice of rotations in the cane fields. One might expect that some explanation would have been offered for this immunity, whether because of careful cultivation, free draining soil, climate and so on, but the author is silent on the matter. The list is very short: red rot, smut, top rot, gumming, root disease, pineapple disease, two leaf spot diseases and streak; and none of these is regarded as of any great importance at present.

Red rot is prevalent, although in recent years seldom sufficiently widespread to cause serious loss. It is, however, reported that in former years this disease was sufficiently dangerous to cause the disappearance of some of the best cane varieties, such as Louzier, Bambou, Bois Rouge, Bellonget and Port Mackay. The description of the fungus, its mode of attacking the canes and the injury caused, is largely based on BUTLER's work in India; but the illustration (from a local photograph) seems dubious, in that there is no sign of the white transverse blotches of air containing dead cells, which are so characteristic of canes attacked by red rot in the field. No reference is, moreover, made to the fact that red rot frequently causes failure of the germinating sets, and, in fact, is considered rather a disease of the sets than of the mature canes in Louisiana. Incidentally, in discussing the rind fungus, the author refers to *Melanconium sacchari* as a saprophyte, only capable of attacking cane tissues weakened from other causes: this is of interest, because of the apparently varying degree of parasitism of this form in different parts.

Smut is present in Mauritius and occurs chiefly on canes of the "Indian type," under which term are included the various POJ seedlings which have Indian blood in them; but DK 74 among the thick canes is said to be badly infected. The author distinguishes between aerial and soil infection of healthy plants as follows, although no data are given for the conclusions arrived at: "When infection occurs through the aerial parts of the cane, the stalks grow normally for a certain period. Then suddenly from their respective growing points will be produced the abnormal shoots described above. When, however, almost all or several of the shoots of a stool exhibit early symptoms of the disease, that is, the thin, grass-like appearance, immediately after their emergence from the soil, as very often happens in cases of disease in this island, it is a sign that the underground system of the cane is infected. This manner of infection is accomplished by means of spores blown to the soil from a smutted shoot in the vicinity." It is stated that experience in Mauritius has shown that dry conditions in the early stages of growth considerably assist in the spread of the disease; but, as growing conditions improve, this is checked and healthy shoots may appear on diseased stools. The author appears to have some doubts as to the passing on of this disease by cuttings from diseased plants, although this has been fully demonstrated in Java and India. Little accurate knowledge exists as to the exact means of the spread of smut or indeed of its life-history in the cane, and the above remarks appear to be of interest. The writer's experience of this disease in India emphasizes the selective power of this fungus. Many Indian canes are liable to attack, and this susceptibility is passed on to their seedling descendants, so that resistance is an important parental character in the raising of seedlings. The Saretha group appears to be specially susceptible among these forms ; but here and there thick canes, often of very good quality are also liable to attack. In the latter case, however, little harm is usually done, in that it chiefly is in the small basal shoots present towards harvest time that the smut appears. This disease assumes a new importance because of the tendency, in many parts, to fall back upon thinner canes for crop purposes, e.g. the POJ seedlings referred to : many of these are liable to smut attacks and, even when the actual extrusion of the black spore mass does not appear, the juice of the canes is bound to suffer if the fungus is in the cane.

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[1] Diseases of the sugar cane in Mauritius. E. F. S. SHEPHERD. Bulletin 32, General Series, Department of Agriculture, Mauritius, 1926.

Gumming.—Very little information is given as to the extent to which the cane fields of Mauritius are attacked by this important disease ; although from what precedes we gather that no great damage is caused by it. The author states, however, that no varieties have been brought to his notice which are entirely immune to it, but that there is great variation in the amount of susceptibility. H 109 is noted as being more attacked in the farm plots in Mauritius than the other varieties. The only remedial measures suggested are the examination of the cuttings for red marks (although MATZ in Porto Rico considers these not to be necessarily present) and the planting of resistant varieties. No reference is made to the special leaf markings described by MATZ as symptomatic. According to evidence collected on the spot, the author states that the severity of the disease depends on the care taken in the cultivation of the crop, and the avoidance of any conditions adverse to the growth of healthy plants. Gumming appears to be extending to a dangerous degree at the moment in several places, for instance, Porto Rico and Queensland; and it will be interesting to keep an eye on all places where it is at all widespread. If Mauritius keeps it in subjection, the causes of this should be ascertained by those suffering from its ravages.

Top rot is a disease of a composite nature and may arise in various ways. This name has been long applied in Mauritius to a disease "marked in its early stages by the soft rotting of the undeveloped leaves or heart surmounting the terminal bud of the cane stem, and finally by the decay of part or all of that portion of the sugar cane stalk enclosed by and including the enveloping leaf sheaths, known as the top." The author regards the disease as not due to any specific fungus or bacterium, but to the direct or secondary effect of various adverse factors, all of which produce a similar result. Such a factor may be a lack of water supply to the cane, and this may be due to deficiency in the soil, the destruction of a portion of the root system, or any interference with the water conducting tissue, whether by fungi, bacteria or boring insects. "The reduction of the water supply to the top as a result of any one or more of these factors tends to reduce the vital activity of the tender growing tissues of the heart of the cane, which thus becomes a ready victim to soft rotting bacteria." An example is given of a field of M 55 canes, growing on exceptionally porous soil in the Black River district. A large number of stools showed leaves withering from the top downwards along their edges, and wherever this withering was in an advanced stage, soft rot of the apex was noted. Most of the growing points were, however, unaffected, and an increase of the water rate to this portion of the field caused the canes "eventually to resume their normal healthy growth."

In this manner top rot may also occur as a result of red rot, gumming or root disease. Most types of top rot, it is stated, can be avoided by planting healthy cuttings and giving them good growing conditions.

Root disease is, according to SHEPHERD, the most common infection of the sugar cane in Mauritius. It is caused by the decaying of part or all of the underground portions. On digging up an infected stool there is a marked absence of white, active roots, and the result is a general retardation of growth above ground, sometimes accompanied by a folding of the leaves from the edges inwards. In most cases the return of favourable conditions of growth causes a recovery of the shoots. In 1918, investigations conducted in Mauritius showed that the disease might be caused by one or more weakly parasitic soil inhabiting fungi, but even typically diseased plants were seen to recover when removed to more favourable conditions. Various organisms were met with among the roots suffering from the disease; a mycelium resembling that of *Marasmius sacchari* (apparently living only on dead roots), Rhizoctonias, Fusarium, a fungus like Pythium, *Thielaviopsis paradoxa* and nematode worms. But the author concluded that these were only effective when the roots were in a weak condition. "None of the organisms found associated with dying sugar cane roots and rhizomes, and which are believed to be capable, independently or collectively, of causing the death of these organs, will apparently do so if the stools are in a vigorous condition." The adverse circumstances responsible for the weakening of the roots may be lack of aeration caused by waterlogging, extreme dryness, or lack of suitable nutriment, as also the attacks of other diseases or insects. A considerable loss of tonnage is stated to result in Mauritius from this disease, but "much can be done by employing better cultivation methods." One curious practice is said to have been successfully employed on certain estates, namely, the exposure of the roots for a couple of days to sun and air, and then the addition of 1½ lbs. of quick lime per stool, at the same time re-covering the roots with earth.

Pineapple disease is also met with. The author does not consider that the peculiar odour, which has given its name to the disease, is a symptom to be relied on. The cuttings are rarely completely destroyed or the shoots seriously affected, unless the germinating buds are delayed by prolonged dry weather. The fungus is said also to attack aerial parts through borer holes, producing symptoms very similar to red rot. (Is it possible that the known destruction of the sets by the red rot fungus referred to above may be responsible for this, as well as for the absence of the characteristic smell?) The control measures recommended are the selection of healthy sets (by the red marks employed for red rot), and then immersing them in Bordeaux mixture, with subsequent drying to soak it in.

Leptosphaeria sacchari and a Helminthosporium cause spots on the leaves and are widespread in Mauritius, but do not usually cause sufficient damage to warrant remedial measures.

Mosaic disease is mentioned because of an outbreak in the nursery on certain Coimbatore seedlings introduced. These were immediately destroyed, and since then, after a rigid inspection, no further trace of this disease has been met with.

Streak appears, however, to be present, and was first seen by the author in April, 1925. Specimens of affected leaves were sent to STOREY in Natal and identified. At present this disease has only been found on RP 8. It has also been seen on maize, *Coix edule*, and some seven native grasses. Good illustrations are given of Streak and Mosaic after STOREY and KUNKEL respectively, as well as from local photographs of the roots and mycelium in root disease. C. A. B.

Fire in the Cane Fields.

The Board of Trade of the South African Union, in its Report on the Natal Sugar Industy, does not mince matters in condemning the practice of letting fire into the cane fields. As it points out, in this as in other questions, there is a good deal to be said on both sides, and doubtless rather strong local opinions are held. It is perhaps well, now and then, for a body of impartial and non-technical public men to be called in, patiently to hear both sides, and then make their recommendations from a common sense point of view.

The Uba cane which is the one universally grown, like most indigenous Indian canes, has very closely adhering leaf sheaths; and these require a good deal of labour to detach when the canes are being prepared for the mill. Burning them off in the field is much easier, and this is especially useful in Zululand, where the growth is heavy and labour is scarce: in Natal the practice is usually condemned, and labour conditions are less stringent there.

But, besides this natural defect of the Uba cane, quite a number of other factors enter into the problem. Burned cane, being thus killed, deteriorates rapidly if not brought quickly to the mill and crushed at once. Trashed cane (the term locally applied to cane from which the leaf sheaths are removed by hand) suffers a good deal less from this danger. Again, burning the field destroys a valuable manurial substance: the cane trash of dead leaves, when dug in, tends to greatly increase the humus content of the soil; and the loss of this vegetable matter is specially to be deprecated in Natal, where the cane is so long in the ground, in that it cannot easily be put in in any other manner. The yields of cane are said to be steadily decreasing both in Natal and Zululand, and this is currently ascribed to the decrease in humus content of the soil. On the other hand, in low, wet lands, it is claimed that a mass of decaying vegetable matter tends of sourness, and that burning the trash will not seriously deplete the stock of humus, which is usually greater in such soils.

The Board, in summing up, takes a long view: whatever other factors may be concerned, it regards the loss of humus as the main thing to be held in the foreground. Allowing that some hardship may be suffered at first where labour is scarce, it considers that in the long run, if burning is abolished, both the planters who practise it and all other sections of the industry will benefit. It therefore recommends that, for the next five years, hand trashed cane shall receive a higher price at the mills than burned cane; and that, after this period, burning shall be made illegal. It is correct, we believe, to say that this ruling will be acceptable to the great majority of those engaged in the Natal sugar industry, whether planters, millers or scientific experts. It may also be noted that Natal is fortunate in not suffering from any insect attacking the canes severely enough for it to be countered by burning the fields.

The practice of firing the cane fields is probably as old as the industry itself. This is now most usually done after the canes have been reaped, to save labour, and get the land cultivated at once. The burning of the fields with standing cane is not so common, and this practice appears to have been introduced, either to cleanse the fields of pests and diseases or to make cutting easier. Besides the example of Zululand given above, where the adherent leaf sheaths are the main reason given for the practice, here and there we meet with cases where the cultivators are unwilling to enter the fields, because of some inherent defect or danger, which can be removed by burning. Thus, the writer recalls that in the West Indies, when a field was known to be badly infested with Mucuna (cowitch), an "accidental" fire might be looked for: in Java similar action has recently been recommended, where the "slug-caterpillar" (Limacodid) is abundant, as it readily detaches its poisonous spines in the hands and arms of the cane cutters. Demerara and Surinam may be quoted as examples of countries where standing cane has been burned before cutting from the commencement of the industry, and it has been a practice in Hawaii for a number of years.

We can look much further back for cases where the cane fields have been burnt because of pests and diseases which render the crop unprofitable. Long before there was any knowledge of the principles of soil fertility, curious remedial methods were adopted. In the days when plagues were attributed to the malign influence of supernatural powers, the cure consisted in religious assemblies and votive offerings. OVIEDO and HERRERA state that the whole of Hispaniola (Cuba) was subject to the attacks of an ant, which, in 1518, overran the island devouring all vegetation, causing famine and nearly depopulating the country. "In order to get rid of these scourges, great processions and vows were made in honour of St. Saturnin: the day of the saint was celebrated with great solemnities, *and the ants disappeared afterwards gradually.*" The "sugar ants" (*Formica omnivora*) which appeared in immense quantities in the Barbadian cane fields in 1760 were, on the contrary, attacked by the planters with the greatest ferocity: they appeared to have had no superstitions in the matter. Poison and fire were freely employed. Corrosive sublimate was found to be specially efficacious, as the ants became insane and pulled one another to pieces. Burning charcoal was quickly extinguished by the immense numbers which threw themselves upon it. Pits were accordingly dug at intervals in the cane fields, and a fire made in each. The flames were quickly smothered, the place being marked by a heap of dead ants the size of a mole hill. These direct attacks appear to have been entirely unsuccessful, and the ants only disappeared after the hurricane of 1780.[1] The nearest approach to this method at the present time is, perhaps, the flame throwing against flights of locusts mentioned in a recent campaign in the Philippines.

The passing of fire over the fields after harvesting the canes has been resorted to for many years. It is the common practice in India, where sugar cane is hardly ever grown for two successive years on the same ground, and the land has to be prepared for some other crop (usually rice in South India). But in that country fuel is very scarce, and most of the trash is used to eke out the bagasse in boiling up the juice. Paddy follows sugar cane regularly in Java, and a like practice prevails. Burning the trash is also the rule in Queensland and in Porto Rico, and doubtless in many other places. On the other hand, the British West Indies, Mauritius, Cuba and Natal (as distinguished from Zululand) take a great deal of trouble to preserve the trash and incorporate it with the soil or keep it as a mulch. It is somewhat strange that this diversity in practice should exist at a time when it is generally recognized that the chief present day defect in the cane fields is the lack of humus.

But another factor has to be considered, namely the occurrence of pests and diseases in the canes. In Egypt, the recent invasion of the newly introduced canes by a mealy bug (*Pseudococcus*) can only, according to those who have studied it, be effectively dealt with by burning all residues after the crop has been cut. But here again the fuel question comes in; it is so scarce that the felaheen have a vested interest, and are accustomed to glean off every bit of trash to augment their scanty supply of burning material. In Fiji burning off the like residues is recommended for the destruction of the weevil borer, care being taken to discountenance the practice on poor soils. In Queensland, however, some doubt appears to exist because of the fear lest this action should also destroy the recently introduced parasite of this borer. Undoubtedly, destroying all old canes and underground residues will be of great service in all cases of insect attack.

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[1] *Science Progress*, 1897, pp. 462–482 and SCHOMBURGK, History of Barbados, 1847.

But by far the worse and most widespread enemy among the canes is the so-called "moth borer," a term which includes a considerable number of species, according to country; and this may be regarded as one of the chief reasons for burning off the trash in most places. But this action has not apparently relieved the situation in Demerara and Porto Rico, any more than the firing of the fields in the old time Barbados experiment against the sugar ant.

With our increased knowledge of the fauna of the cane fields, the presence of parasites on the insect pests has been everywhere demonstrated; and a little thought will convince anyone that these minute "flies" must have much less chance of escaping a running fire than the stronger flying pest itself, many members of which, moreover, are snugly ensconced inside the canes or even in the underground parts. The most intensive study during recent years of this aspect of the question has, perhaps, been that carried out in Porto Rico, where it has been abundantly demonstrated that burning the trash tends actually to increase the numbers of moth borer, presumably because they are freed to a great extent from their parasitic enemies.

The loss in fertility in the cane fields by burning off the trash instead of digging it into the soil has already been sufficiently indicated; but, besides this, the heat of the fire sometimes has a very destructive effect upon the humus already there. The classical example in tropical agriculture of the destruction in this manner of vegetable matter which, among other things, forms the necessary food of the nitrogen-fixing bacteria in the soil, is found in the clearing by fire of forests for cultivation. The soil in these forests is immensely rich in humus, gradually accumulated by the droppings from the trees for many years, if not many centuries; and the top layers are in the main formed of this substance. The damage done by fire is well seen in those parts of the east where *kumri* or *chena* cultivation by the hill tribes has been allowed. Most of the high hills in India are dotted over with bare patches where, in former years, *kumri* cultivation has been carried on : it is reckoned that it will take at least 100 years in most cases before the bare patches will be able, if the forest grows again, to bear comparison in fertility with their former state; and this damage has been done in order that the cultivators might secure a couple of meagre grain crops. Very similar in kind, though not in extent, is the damage that has been done in many places by clearing the forests by European planters for coffee, rubber, tea, etc. A striking observation which has, we believe, once before been put before our readers, was made by a planter in South India. Before the forest was felled and burnt, for some reason not stated, he drove into the ground a series of yard long iron stakes, so that the upper ends were exactly flush with the ground. After the fire had passed, he was much surprised to see his iron stakes projecting, on an average, six inches above the surface; and he naturally concluded that the top layer, consisting almost entirely of decayed vegetable matter, had been burnt right off. This top layer of forest soil has been carefully analysed, and found to be equal in manurial constituents to the best farm yard manure. It is reckoned that the hill sides which were first cleared for coffee planting in Coorg in South India will take from 100 to 150 years to recover their former fertility.

But, concurrently with the direct damage done to the soil by passing fire over the canefields, whether before or after cutting the crop, the question of soil moisture must be considered, for humus has a surprising capacity of retaining moisture. This is of course a matter which is of the greatest interest to those countries where the periodic rains fluctuate in amount, for instance, as in some of the smaller West Indian islands. Hence, no doubt, has arisen the invariable practice in these islands of carefully digging in the cane trash after harvest. The writer may be excused for drawing on his memories of some thirty years ago, to illustrate this point; and, incidentally, this will help to indicate the great change in scientific opinion which has taken place on this matter since then. When the "rind fungus" (coupled with the unfair competition with bounty fed beet sugar) was threatening the British West Indian sugar plantations, a leading authority at home wrote out that really the best way to deal with the matter would be to burn all the plantations in Antigua together with the borer and the fungus disease, and not to allow any sugar cane to be planted for a couple of years; and then start afresh with renewed soil and plants free from disease. It took but little local study to be able to point out the disastrous effect of such action on the soil. As luck would have it, the year was one of early drought, and numbers of young fields were dying out. Foremost among these were noted some dozen, in all of which firing the fields had been practised, whether intentionally or not. This was considered a sufficient answer to send home, as to the desiccating effect of burning on the soil.

Taking all these aspects into consideration, it is not surprising that the introduction of fire into the canefields is very rarely advocated by responsible authorities at the present time; the wonder is, rather, that this agricultural anomaly still survives in cane cultivation in so many places. With the exception of a few isolated and special cases, stringency in labour conditions remains the only valid reason for the practice.

But we cannot leave the matter thus. With the best of intentions, cane fires will happen, and this of course just at the season when they are most difficult to control. All sorts of things may start a cane fire accidentally—a dropped match on the grass or the end of a cigarette which we thought was out, a spark from a pipe, a cinder from a passing locomotive chimney, a camp fire not completely extinguished, and so on. And the chief danger lies in the fact that the first stages are so slow and inconspicuous, smouldering for a long time before the first tiny flame, so that we may be far away before the first signs of the results of a careless action become evident. A cane fire is an awesome spectacle, especially if unexpected and at night—the roar of its progress, the immense volumes of smoke, and the occasional sheets of flame thrown far into the heavens, all are startling and confusing. To start such a fire is the easiest thing in the world, to put it out one of the most difficult. Incendiary cane fires have always been a ready weapon in the hands of a discontented labour force: if we mistake not, the burning of the cane fields was the first step adopted by the revolted slaves in Hayti; after which, the massacre of their French owners was comparatively easy.

And thus the means of fighting these fires becomes a matter of some moment: they are dangerous to life and property and disastrous to the fields. But this article is already long enough, and we will in conclusion draw the attention of those concerned to the methods adopted in Hawaii, as disclosed in an interesting paper which is reproduced on another page. It is obvious that the matter is taken seriously in that territory; and with their usual thoroughness, the planters have worked out a general scheme for meeting the danger. The methods are of course adapted to the local conditions, and will require considerable modifications before being applied elsewhere; but the paper contains a great deal of useful information, and is an important addition to the scanty literature of this difficult and intricate part of plantation work.

C. A. B.

Rare Cases of Mosaic Disease in Highly Resistant Varieties of Sugar Cane.[1]

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EARLIER OBSERVATIONS ON RARE CASES OF MOSAIC.

Prior to the summer of 1925, the time of the observations herein recorded, the opinion was generally held by cane growers and investigators that several well-known members of the group of slender fibrous sugar cane varieties of the Chinese type were immune to the mosaic disease. Indeed, in 1919, when this disease was first definitely ascertained to be present in continental United States, the early systematic inspections of variety plots on the sugar cane experiment fields of the United States Department of Agriculture at Cairo, Ga., and of the Louisiana Sugar Experiment Station at New Orleans, gave rise to an impression that all varieties of that type then growing in these fields were probably immune.[2] Later in the same year (August 14th, 1919) the writer found a prominent case of the characteristic leaf-mottling symptoms of mosaic on one variety of this type of Japanese origin, the Kikaigashima.[3] Shortly after this the writer observed the symptoms also on other varieties of this type, also of Japanese origin, including the Oshima, Yontanzan, and Chikucha, and similar observations were reported to the writer by E. W. BRANDES. In 1921, successful experiments were made by BRANDES and KLAPHAAK[4] in transmitting the mosaic to five varieties of this type—Khera, Chikusho (Tekcha), Kagawa Ken, Kikaigashima, and Chikucha. Transmission experiments at the same time gave negative results with Uba, Kavangire, Cayana, Merthi, Kinar, and Oshima.

MOSAIC NOW FOUND IN VARIETIES SUPPOSED TO BE IMMUNE.

The more frequently mentioned varieties of the slender fibrous Chinese type, which were generally thought to be immune to mosaic, are Uba, Cayana, Kavangire, and Old Small Japanese, all of which are in the collection at Cairo, Ga. Up to the autumn of 1924, the mosaic had not been observed in these varieties, so far as the writer is aware. During that autumn the writer's attention was called to mosaic symptoms of a stool of Uba at the sugar cane experiment field at Cairo by an employee, B. A. BELCHER. The leaves presented the distinct mottling characteristic of the mosaic disease. This case was so unusual that it suggested a possible accidental admixture of another variety on the plot. Other duties prevented immediate further inspections at this time, and a systematic inspection planned for other plots of this variety and of other varieties of this type during the same season was frustrated by an unexpected early frost which killed the leaves.

During the summer of 1925, however, while the cane was at an earlier stage of growth and the mosaic was more easily distinguishable, the writer made a close inspection of many plots of this variety and of all the other varieties of this type on the experiment farm. A few stools with the characteristic mottling of mosaic were found not only in the Uba cane but also in all the other imported varieties of this type on the farm, including Old Small Japanese, Cayana, and

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[1] Reproduced from U.S. Dept. of Agr. Dept. Circular 392.

[2] See appendix.

[3] P. A YODER, "Growing Sugar Cane for Syrup." *U.S. Dept. Agr. Farmers' Bul. 1034 (Rev.)*: 1922. p. 29.

[4] E. W. BRANDES and P J. KLAPHAAK, "Cultivated and Wild Hosts of Sugar Cane or Grass Mosaic." *Jour. Agr. Research* 24: 1923. p. 255.

Kavangire, hitherto regarded as immune. In the case of the Cayana, many plots of from 0·03 to 0·05 acre were closely scrutinized before the first case was found. In a few such plots, however, there were found from three to six stools of mosaic. In the case of the other varieties mentioned above as hitherto considered immune the cases were not quite so rare, compared with the area planted.

In the same close inspection of the other highly resistant varieties of the Chinese type, imported from Japan in 1910 and 1911, the cases of mosaic were found to be distinctly more abundant. This includes Yontanzan, Tekcha, Kikaigashima, Oshima, and Chikucha. With these varieties most of the plots of from 0·03 to 0·05 acre presented one or more cases, some of the plots from 5 to 20 cases.

It is not possible to judge conclusively the degree of resistance to mosaic in these varieties from the extent of the infection observed this single year (1925) without also having a fuller record than is now available of exposure of the individual varieties during previous years. However, it will afford some indication as to probable relative degree of resistance to note that, in rareness of infected stools in plots approximately equally near to highly susceptible varieties in 1925, these resistant varieties stood in the following order: Cayana, Uba, Tekcha, Kavangire, Khera, Chikucha, Yontanzan, Oshima, Kikaigashima, Old Small Japanese. Of these varieties, only Cayana, Uba, Tekcha, and Yontanzan were available for observation in a large number of plots, scattered over various parts of the field. Of the other varieties mentioned, the plots available were so few in number that these observations have less conclusive significance with respect to degrees of susceptibility. It was noted that all the varieties of Japanese origin were much higher in mosaic cases than Cayana and Uba.

EXTENT OF EXPOSURE TO MOSAIC.

All of these highly resistant varieties have been grown for a number of years adjacent to cane of the large-stalk, broad-leaf varieties having a high percentage of mosaic. There is evidence that the mosaic disease was introduced on the experiment farm at Cairo, Ga., in 1916 on cane originating in Louisiana. The Old Small Japanese and the Cayana were on this farm from the same year and therefore have been exposed ever since that time. The Uba and Khera were started on this farm the succeeding year, 1917. Of the later Japanese introductions, the Yontanzan, Tekcha, and Kikaigashima were first planted at Cairo in the spring of 1918 and the Oshima in the spring of 1919. The Kavangire was first planted here in 1921.

In 1919, when mosaic was discovered on this farm, the more highly susceptible varieties, such as Home Purple, Ribbon, Home Green, Green Ribbon, D 74, D 95, and L 511 growing on the farm had from 20 to 80 per cent. of the stools infected with the disease. By 1921, of these varieties that were still grown at this field station, Home Purple and L 511 had about 100 and 50 per cent. respectively, of infected stools. From 1921 only relatively small areas on the experiment farm were planted in these highly susceptible varieties, though neighbouring farms continued to have an abundance of the Home Purple cane with practically 100 per cent. infection. The experiment farm was planted mainly with the highly resistant varieties of the Chinese type. In 1922 and 1923, Java seedlings susceptible to mosaic—POJ 36, POJ 213, POJ 228, POJ 234—and several others from Java were introduced on the farm in small quantities. In 1924 and 1925 large numbers of United States seedlings were introduced on this farm, and among them were many that promptly became infected with mosaic.

Among the resistant varieties of the Chinese type, the number of cases found on plots remote from the more susceptible varieties, like the Home Purple, were notably rarer than on plots adjacent, although in the case of the Cayana such relationship could not be detected. In the latter variety the cases were very rare throughout except on a few plots, and those plots were relatively remote from highly susceptible varieties.

In 1919, when mosaic was discovered at Cairo, all varieties of the thick-stalk, broad-leaf type, the so-called "noble" varieties, then in the collection at the field station were, without exception, found infected with the mosaic. This included Home Purple (Louisiana Purple, Red, Black Cheribon), Ribbon (Red Ribbon, Louisiana Striped, Rayada), Home Green (Green, Otaheite, Bourbon), Green Ribbon (Simpson), Crystalina (White), Palfrey, D 74, D 95, D 1135, L 511, L 218, L 219, L 226, L 231, L 253, Cayana 2, Cayana 3, Cayana 4, Cayana 6, Cayana 7, Cayana 8, Cayana 11, Cayana 13, Cayana 14, Cayana 17a, Cayana 17b, and several others in smaller quantities. Many of these were 100 per cent. infected in 1919 and for that reason were totally eliminated from the collection at the close of the 1919 season. After 1920, on removal of the experiments to another farm also near Cairo, only Home Purple and L 511, as mentioned above, were continued.

During the seasons 1919 and 1920 thoroughgoing inspections were made by the writer of all plots of the varieties of the Chinese type then on the farm, and it is therefore not probable that any of them had stools showing infection except those of Japanese origin already mentioned. After 1920 the inspections were of a more casual nature, but sufficiently detailed to make it seem improbable that there was much infection in any of the varieties before 1924. It seems probable therefore that the incidence of the disease in these varieties was largely in 1924 and 1925.

It is not in the province of this circular to offer any explanation accounting for the difference between the amounts of infection in these varieties observed in 1925 and those observed in earlier years. Whether the seasonal conditions were more favourable for infection, whether the insect carrier became more abundant, whether a more effective carrier came in, whether a more virulent form of the disease itself came in, whether it is a more or less erratic development through agencies continually on hand, or whether it is due to some other cause or combination of causes must remain for future investigations to answer. That the differences in the observations reported are due to differences in the thoroughness of the inspections seems improbable from what was said in the last preceding paragraph. That these recent cases observed are due to an accidental admixture of more susceptible varieties with the highly resistant or immune varieties seems highly improbable, because of the extreme care always exercised on this experiment farm in keeping varieties separate, and because of the fact that this new incidence of mosaic is not limited to one or a very few varieties but applies to all the imported varieties of that type on hand, including the Old Small Japanese cane, which, in size and shape of stalk and leaves, differs so widely from the other varieties grown on the farm that an admixture could readily be detected. That the diagnosis as mosaic is erroneous seems improbable, for the markings on the leaves corresponded with those of mosaic in varieties known to be susceptible, and these plants presented a clear and strong contrast with others of the same varieties adjacent, which were judged to be free from mosaic. This diagnosis was concurred in by several others who had extensive experience with mosaic in sugar cane, including R. D. Rands and P. J. Klaphaak, as well as several employees on the farm.

EFFECT OF THESE DISCOVERIES ON FUTURE COURSE IN THE SUGAR CANE INDUSTRY.

Although it is somewhat startling to discover of a sudden that some popular varieties long thought to be immune[1] are not, this need not necessarily have any serious effect upon practical sugar cane culture. So far as yield is concerned with any of these highly resistant varieties, they may still be considered as good as immune. The number of cases appearing in the varieties formerly supposed to be immune is so extremely small and the evidence of any stunting effect so meagre that it can not have any appreciable effect on the yield, even if the incidence of the disease in a plant does have a stunting effect.

However, in one respect these observations may have an important bearing on future course of action. We can no longer rest assured that we have totally eliminated mosaic of the sugar cane simply by planting exclusively the Old Small Japanese, the Cayana, the Uba, or the Kavangire variety. On this point it should be remembered, however, that with these varieties effective roguing out of the diseased stools should easily be feasible, because of the relatively rare cases of infection. The possibility is not excluded even that by persistent roguing or, more likely, by single-eye progeny selection a strain that is actually immune can be separated from one of these varieties.

NEW HIGHLY RESISTANT OR IMMUNE VARIETIES IN PROSPECT.

Although these 10 imported varieties of the Chinese type can no longer be considered absolutely immune, there are scores of varieties of cane in the collections at Cairo, Ga., Canal Point, Fla., Houma, La., and Baton Rouge, La., which, up to date, have not shown any evidence of mosaic and are, therefore, considered immune. Several of such are imported varieties, but many more are seedlings produced at Canal Point, Fla., by the Office of Sugar Plants of the Bureau of Plant Industry, United States Department of Agriculture, co-operating with the Louisiana Experiment Station. Hundreds of these are being tested at Cairo, Ga., co-operating with the Cairo Cane Growers' League; at Houma, La., co-operating with the American Sugar Cane League; and at Baton Rouge, La., co-operating with the Louisiana Experiment Station. Although most of these apparently immune seedlings are too low in sugar content or too slender and fibrous to be good commercial varieties, a few are of sufficiently high quality to come under consideration as a commercial possibility or at least to give grounds to hope that through seedling production and testing a good commercial variety can be found that is at the same time immune to mosaic.

SUMMARY.

Well-known varieties of sugar cane of the slender, fibrous, prolific type, the Chinese type, are known to be highly resistant to mosaic. They were at one time thought as a class to be immune, but rare mosaic cases were observed in some members of the groups of Japanese origin shortly after the mosaic was discovered in the sugar cane in continental United States. Up to 1924, rare cases of mosaic had been observed on the Kikaigashima, Oshima, Yontanzan, Chikucha, Chikusho (Tekcha), and Kagawa Ken of Japanese origin and the Khera of Indian origin.

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[1] Absolute immunity of a variety of plants or animals to a specific disease means that variety is incapable of contracting that disease under any circumstances. In this sense it is doubtful whether the term can be applied with absolute certainty to any variety of plants or animals with reference to any disease to which its species is susceptible. In common usage, therefore, the term must be understood to imply merely that it is known that individuals of the variety have been abundantly exposed to infection without contracting the disease and that no cases have been observed in which individuals of the variety have contracted it. In one sense the use of the term "immune" is analogous to the practice, in legal parlance, of considering the defendant innocent until proved guilty.

The Uba, Cayana, Kavangire, and Old Small Japanese are well-known members of this group that were hitherto generally thought to be immune.

In the fall of 1924 the writer observed a case of mosaic in Uba at Cairo, Ga., and during the succeeding summer a systematic search through the experiment plots at the sugar cane field station at Cairo revealed cases of mosaic in all the above varieties hitherto thought immune, and more numerous cases in the other varieties mentioned of this type than had been observed previously. In resistance to mosaic as evidenced by the rareness of cases found in this inspection in comparison with areas planted, the varieties of this type then grown at Cairo stood in the following order: Cayana, Uba, Tekcha, Kavangire, Khera, Chikucha, Yontanzan, Oshima, Kikaigashima, Old Small Japanese.

These varieties had been exposed to mosaic infection in the Cairo collection as follows: Old Small Japanese and Cayana since 1916; Uba and Khera since 1917; Yontanzan, Tekcha, and Kikaigashima since 1918; the Oshima since 1919; and the Kavangire since 1921.

Because of the scant amount of infection and the lack of evidence of any serious stunting effect on these varieties which were formerly thought to be immune, they can still be considered as good as immune so far as yields are concerned, but the fact that they are susceptible must be taken into consideration in proposed distributions to non-infected localities and in programmes of total elimination of mosaic from a locality by planting only these varieties. Because of rareness of cases, a roguing programme should easily be effective in eliminating mosaic from these varieties.

A few other new varieties have been imported and many more have been produced from seed at Canal Point, Fla., and are being tested, that are highly resistant or immune to mosaic, and there are good prospects that other successful commercial varieties will result from this work.

Appendix.

NOTE ON CANE NOMENCLATURE.

Much confusion exists in the names applied to varieties of the Chinese type[1] of cane, mainly through the application of the name "Uba" indiscriminately to the progeny of several lots of cane, imported from widely different sources, which happen to resemble one another very closely. This is unfortunate, for the writer has evidence indicating that some of these varieties which look alike are notably different in cultural qualities and in disease resistance. The following notes on names and importation history will help to identify the particular varieties and strains included in this report. With the exception of the Old Small Japanese, all these varieties are so similar that it would be difficult, if not impossible, to distinguish them as they are growing in the field.

Old Small Japanese.—This is the Japanese cane that has been grown for many years in the Gulf States for forage and for syrup. It was procured from a neighbour for the field station at Cairo, Ga., in the spring of 1916. It is decidedly more slender in stalk and leaves and the joints are more enlarged than any of the other varieties here discussed.

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[1] It may be noted that the author habitually speaks of these thin canes as of the "Chinese type." This is probably in accordance with local practice in the U.S.A. It is more usual to refer to the thin canes of the Uba type as of "Indian origin," and this we believe to be correct. There is no evidence offered that any of these canes are of Chinese origin; and it has been authoritatively stated that there are no varieties of sugar cane indigenous in Japan. All except Old Small Japanese are stated by the author "to be so similar to one another that it would be difficult, if not impossible, to distinguish them as growing in the field." Since Uba has been definitely assigned to the Pansahi group of indigenous Indian canes, it would, we consider, be preferable to drop the term "Chinese" altogether. It is applied somewhat loosely elsewhere to altogether other kinds of canes.—ED. *I.S.J.*

Cayana (originally called Cayana-10).—Two cuttings imported by the U.S. Department of Agriculture in April, 1914, under S.P.I. No. 38902 (S.P.I. denotes Office of Foreign Seed and Plant Introduction of the Bureau of Plant Industry) from the Centro Agricola at Bahia, Brazil. The progeny was all sent to Cairo in May, 1916, when released from quarantine at Washington. Because other Cayana varieties imported with Cayana-10 have since been eliminated, the distinguishing number 10 may be dropped in the name of this single Cayana variety retained.

Uba.—Twelve cuttings received from Natal through Pretoria, Transvaal, South Africa, September, 1915, imported under S.P.I. No. 41154. The progeny, after release from quarantine in the spring of 1917, was divided between the station at Cairo, Ga., and the Louisiana Sugar Experiment Station at Audubon Park, New Orleans.

Khera.—Imported from Aligarh, United Provinces, India, in 1912, under S. P. I. No. 33242, and planted at the Cairo station first in 1917.

Yontanzan.—Nine cuttings imported from Okinawa Ken, Kiushu, Japan, through the Yokohama Nursery Co., June, 1910, under S. P. I. No. 28193. It was sent by the U.S. Department of Agriculture to the Florida Agricultural Experiment Station and from there was sent to the field station at Cairo, Ga., in March, 1918. The name supplied on the importation card is "Yomitani yama." This name, as explained to the writer by Japanese visitors (Kumanosuke Teniguchi, of Japan, and Masao Yoshikawa, of the United States Department of Agriculture, Washington), is a pure Japanese pronunciation of the Japanese or Chinese characters used in the name. The pure Chinese pronunciation of the same characters is "Yontanzan," but the name actually used for the variety in Okinawa Ken by both the native inhabitants and the Japanese sugar cane people is "Yontanza." Since, however, the name "Yontanzan" has already entered the English literature on sugar cane, the writer chooses to retain it.

Tekcha.—Imported from Japan through the Yokohama Nursery Co. in December, 1910, under S. P. I. No. 29106. It reached the Cairo station through the same route as the Yontanzan. (See above.) The name supplied on the importation card is "Chikusho." This is probably an erroneous pronunciation of the two native Chinese or Japanese characters meaning bamboo ("chiku" in Japanese and "teki" in Formosan Chinese) and cane ("sho" in Japanese and "cha" in Formosan Chinese). As the name "Tekicha" or "Tekcha" is a familiar name of a cane variety in Formosa, and as this name is also adopted by the Japanese, the writer assumes that the correct name is "Tekcha."

Kikaigashima.—Imported from Kagoshima Ken, Japan, through the Yokohama Nursery Co., December, 1910, under S. P. I. No. 29108. Received at Cairo station in January, 1918, from the plant introduction field station of the U.S. Department of Agriculture at Brooksville, Fla.

Oshima.—Imported from Kagoshima Ken, Japan, through the Yokohama Nursery Co., December, 1910, under S. P. I. No. 29109. Received at the Cairo station in March, 1919, from Henry C. Bystra, Brooksville, Fla., who got it from the Florida Agricultural Experiment Station, to which station it was sent by the U.S. Department of Agriculture.

Chikucha.—Imported from Tainan, Formosa, Japan, April, 1911, under S. P. I. No. 30464. It reached the Cairo station through the same route as Yontanzan. (See above.) This name supplied on the importation card is probably an erroneous combination of a Japanese pronunciation ("chiku"=bamboo) of one native character and a Chinese pronunciation of another character ("cha"=

cane) and should probably be given the Formosan Chinese pronunciation Tekicha or Tekcha. (See also Tekcha above.) It is probably a different strain of the familiar Tekcha variety. It differs in physical characteristics, especially in width of leaves, from the Tekcha imported under S.P.I. No. 29106, mentioned above. For want of a better distinguishing name, Chikucha is retained in this report.

Kavangire.—Imported from Tucuman, Argentina, in the summer of 1919, under S. P. I. No. 48076, and planted at Collins Key, near Miami, Fla., and from there sent to the Cairo station in the autumn of 1920 and planted in the spring of 1921.

The Sugar Crop of Northern India for Season 1925-1926.

From an Occasional Correspondent.

During the season 1925-26, 19 factories operated in Northern India. Although complete statistics are not available, no substantial error arises in giving the total cane milled as about 675,000 short tons, from which was produced 54,000 tons of sugar more or less, making the average yield very close to 8·0 per cent. The largest quantity milled in any one factory was 64,000 tons and the highest yield reported from any one factory was 9·48 per cent.

Although data are far from complete, it would appear likely that the sugar content in the cane was lower than usual. This observation is to be connected with a severe epidemic of top borer, *Scirpophaga Sp.*, which was prevalent over the whole of Bihar and the U.P. A second cause contributory to a lower sugar content is to be found in the earlier start, due to a crop considerably in excess of any yet produced in the areas whence the 19 mills that operated draw their supplies; and yet a third cause may be connected with a monsoon more overcast than usual, resulting in less than the average quantity of direct sunlight.

During the past season very considerable areas of the Coimbatore seedlings have been reaped, amounting to some 4000 acres more or less. Of this acreage about 50 per cent. is CO 213, 30 per cent. CO 210, and 20 per cent. CO 214. For the coming season 1926-27, some 7500 acres of these varieties have been planted; CO 213 and 210 representing the major portion of this acreage with a decrease in the proportion of CO 214.

The return from these canes for the season just finished and taken over a very great proportion of the actual area is in short tons per acre:—

	DARBHANGA AREA	CHAMPARAN AREA
CO 210	16	13
CO 213	20	17
CO 214	13	7
Hemza	10	7

Included in the Hemza returns from the Champarun area are many acres severely attacked by top borer, from the effects of which a recovery was never made.

As regards the sugar content of these canes, there is distinct evidence that CO 214 may be profitably milled considerably earlier in the season than any of the others, but based on a series of detailed observations, there is no definite evidence that 210 or 213 are much, if at all, superior in this respect to the Hemza cane.

Although the hopes of a much higher sugar content have not materialized, nevertheless the superior cropping value of these canes, and their suitability to the untoward conditions which prevail in Northern India, have more than justified the labour that has been spent in breeding and in extending the cultivation of these canes, and a very real benefit has been conferred on the cane planting community in the Indo-Gangetic Plain.

Filter-Press Operation in the Cane Factory.[1]

By WALTER E. SMITH.

The problem of maintaining clarification at the optimum reaction is in large part a matter of capacity for the filtration of settlings. Little agreement exists as to the ideal conditions for filter-press operation. Filtration as a chemical engineering problem has received considerable attention, but specific data pertaining to the filtration of cane settlings are far from adequate enough to enable us to definitely lay down a series of rules for the conduct of this operation. Assuming that filter-press equipment is in good mechanical order, that the frame surfaces are clean and permit proper tightening, that the cocks are in good tight condition, and that the inlet and outlet ports in the frames are free from obstruction, there remain two principal factors on which no agreement seems to exist: First, pressure of filling; and second, reaction of settlings.

The matter of pressure is found to vary among our best factories from as low as 10 lbs. to as high as 40 lbs. per sq. in. The writer cannot conceive of such radical differences in the filtering characteristics of settlings as to make these extremes justifiable. Surely both cannot be equally efficient, and yet the fact remains that data are not at hand to definitely demonstrate the efficiency or correctness of either pressure.

While formulae for filtration developed in chemical engineering practice may not be specifically applied to the solution of our problems, they at least indicate the factors involved, and from them we may arrive at an understanding of the most beneficial operating conditions. Filtration may be considered as a flow through a capillary tube, for which the equation shows flow to be proportionate to the pressure and to the fourth power of the radius of the tube, other conditions being equal. With a gelatinous, highly compressible material such as cane mud, it seems quite obvious that the porosity of the cake will be affected by increased pressure. Since decreasing the radius of the interstices of the cake one-half will reduce the rate of flow to one-sixteenth, the importance of the appropriate pressure becomes apparent.

When handling solids of crystalline or granular texture, increase of pressure results in almost proportionate increase of filtrate, but with a flocculent precipitate the head may often only be increased a few feet before a contrary result is obtained. WRIGHT[2] says: "The reason that, in practice, the law of increased pressure does not always increase the flow, is found in the fact that in filtration the orifice (i.e., cake porosity) becomes a variable under pressure. For every material there is a pressure above which an increased flow is not obtained, but a decreased flow is had instead. This is known in filtration parlance as the *critical pressure* for that material."

These theoretical considerations are well borne out by observations made under actual working conditions. One factory noted for the excellence of its filter-press work, as measured by the low polarization of the press cake, employs a gravity head equal to a pressure of 10 lbs. per sq. in.

Obviously filter-press work must be considered as a combination process of filtration and washing, and filtration proper must proceed in such a way as to leave the resulting cake permeable to water so that excessive time is not required for washing; unless this condition is met, any saving by the use of high pressure is lost through the extended time required for sweetening off the mud. At the factory in question, timing of the filtration cycle over a period of three days gave an average of two-and-a-half hours for filling, and a few minutes over two hours for washing, resulting in a press cake of approximately 1·0 per cent. polarization.

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[1] Abstracted from Reports of the Association of Hawaiian Sugar Technologists, October, 1925.

[2] ARTHUR WRIGHT: "Industrial Filtration" (Chemical Catalog Co.).

These results compare favourably with any being secured at other factories and demonstrate the effectiveness of low pressure filling. Ease of washing press cake to a low polarization in a short period may be accepted as an indication of cake porosity, which, in turn, is a measure of the interstices between the solid particles making up the cake. This should indicate a high rate of flow, a condition actually demonstrated by the short filling time quoted.

During the past season the writer had opportunity to experiment with filtration of settlings at two factories, one where the settlings came from juices low in phosphoric acid and were comparatively low in volume, the other from juices moderately high in phosphoric acid and the volume of settlings so high as to constitute a serious problem in clarification.

In the first case, under customary operation, the pressure was allowed to build up to 40 lbs., at the end of the cycle, the filtering cycle varying from three to seven hours. The polarization of the press cake averaged approximately 2·5 per cent.; nine presses were used, these being frequently of insufficient capacity. A centrifugal pump was installed and operated to give 18 lbs. pressure at the presses; the number of presses in service was reduced to the minimum, each press being forced to the limit at the pressure available. Under these conditions it was found possible to fill the press in somewhat less than three hours, but to reduce the procedure to routine, the filling cycle was arbitrarily set at three hours, washing being likewise set at three hours per press. The net effect was to reduce the polarization of the cake to approximately 1·5 per cent., at the same time increasing the capacity of the station to such an extent that usually at least three presses stood empty. The quality of the press work was such that the juice was taken direct to the evaporators and at no time was difficulty experienced with broken cloths or dirty juice.

In the second case, filtration had been conducted at a pressure of 35–40 lbs., with washing following at 50-60 lbs. At this pressure the leakage during washing was so great that the full maceration requirements of the mill were met by the quantity of sweet-water produced, amounting to 1600 per cent. on the weight of cake. When the presses were filled by centrifugal pump at 15–20 lbs. pressure, no difficulty was experienced in maintaining a rate of flow equal to that obtained at 40 lbs. The leakage was materially lessened when the washing pressure was reduced to 30 lbs., and the polarization of the cake dropped to about half of that secured on preceding days. Likewise, juice leakage during filling, and the danger of broken bags was so reduced as to make it possible to divert the filter-press juice direct to the evaporators, a practice previously considered unsafe.

In general, practical data available indicate that the critical pressure for cane settlings is more likely to lie below 20 or 25 lbs. than above, and high pressure does not seem advisable, particularly since this increases the danger of broken bags and thus makes unsafe the practice of returning press juice direct to the evaporators.

Filtration practice, in beet sugar manufacture as well as in other chemical engineering industries, is almost unanimous in favouring the use of centrifugal pumps for press filling, though for pressure up to 15 lbs. most cane factories could conveniently arrange a gravity feed. This is equally satisfactory, but in many cases would perhaps prove as expensive as the installation of a centrifugal pump.

One further factor of considerable importance is the reaction at which filtration is conducted. In many factories the settlings are carried distinctly alkaline to phenolphthalein, while in others no further lime is added to the settlings after the original liming of the mixed juice. Perhaps a slight increase in rate of flow is secured by adding sufficient lime to bring the juice to approximately *pH* 8·0-8·5, but other considerations would indicate that this reaction should not be exceeded; at this alkalinity the press juice may be safely mixed with the clarified juice without bringing about a new precipitate, if the original liming has been carried to a reasonable degree. It is interesting to note that experiments conducted locally with a type of filter not previously used on cane mud indicated no increase in rate of flow through heavy liming.

Cane Fires.[1]

By J. S B. PRATT, Jr.

Cane fires have such a destructive effect, with loss of investment, water, fertilizer, labour, and growing time, that the suggestion has been made that we discuss at the Sugar Technologists' meeting ways of fighting and preventing fires.

Fires may be *accidental*, *incendiary*, or *intentional*. On a sugar cane plantation, we may have grass, trash, young cane, mature cane, building, and forest fires. In this paper, we will concern ourselves mainly with mature cane fires, but, in passing, it will be well to mention good ways to stop both grass and trash fires.

GRASS AND TRASH FIRES.

The best aids in fighting grass fires are shovels of earth, trenches to prevent creeping, green branches, wet bags, and hoes. Grass fires give so much smoke that it is hard to work on the lee side. It is easier to work with the wind on two sides, pinching it to a narrow point. With large grass fires, time will be saved by using a plough and turning a few furrows. Trash fires are similar to grass fires, and in both buckets of water thrown in a fine spray are very effective in checking the fire at critical points. When using bags, branches, or in throwing earth, be careful not to fan the flames. A large number of our cane fires are started from grass or trash fires, very often because we get careless and burn without regard to wind or to dryness.

INTENTIONAL FIRES.

In Hawaii, we have for a number of years burned off our cane before cutting. There is not only the labour saving in harvesting of very often as much as 40 per cent., but there is the labour saved in starting off the ratoons. J. A. VERRET writes: "Burning off before cutting cane was becoming the general practice about the years 1909 and 1910. Its general adoption was brought about mainly on account of labour shortage and lessened cost of harvesting. The first mention of burning before cutting made in the H. S. P. A. annual committee reports, as far as I have been able to find, was by W. W. GOODALE in 1909. In 1910, L. WEINZHEIMER reported on this practice as then carried on at Pioneer Mill. Among the first places where burning was done was in the Lawai Section of McBRYDE in 1902. Kahuku, as far as I know, was the first place on Oahu. In the beginning, the practice was done not so much as a labour saver as on account of borers. I understand that burning off before cutting is a general practice in South Africa, where Uba is the standard cane. I know of no other country where burning off is practised as a general thing."

Burning off destroys rats, diseased cane and injurious insects, and, of course our friendly insects.

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[1] Presented at Fourth Annual Meeting of Association of Hawaiian Sugar Technologists, Honolulu, October 26th, 1925.

Experience is our best guide to burning off. One learns when to take the fire fast, when to go slowly, how to create a draft to make the sparks go up, when to have plenty of men at a fire, when not to burn, and so forth. At Pioneer, for instance, burning off early in the morning with only a few men at hand is customary. That is their job, to burn off, and to cut the firebreaks for the next day's burn. They become expert at it and use a very narrow firebreak with a small stream of water, taking advantage of an early morning breeze to make it safe. To one not used to burning off in this way, it seems dangerous. These men, however, are trained, are alert, and are active when a spark jumps. Men should be trained to be careful and not to be afraid. It pays to pick men for fires, and the more men are trained in this way, the more fortunate is the plantation when accidental fires occur. They gain confidence and are not afraid when trouble comes. Men of this type are worth sevenfold the untrained men, and with the untrained man there is more danger of loss of life in our accidental fires.

ACCIDENTAL FIRES AND INCENDIARY FIRES.

These happen on the best organized plantations. Someone careless in smoking, a strong unexpected wind carrying a spark far from some burn, dry grass or trash, a locomotive spark, a nitrate bag left carelessly by cane, or even some firebug, disgruntled labourer, or strike agitator will start a cane fire.

Let us follow a cane fire through, telling what we would do and what we would *not* do. Experience is our best teacher for fighting fires, and some of us here may have certain experience to tell our fellow members that may be helpful.

It is night, and Manuel, riding home from a visit to his old father, sees a glare in a nearby field. There can be no mistake in what it is. Fire! Some careless fisherman returning from the beach drops a cigarette in the grass by the road, that should have been cleaned and the cane stripped back a line or two. But the fire has just started, and Manuel gallops on, knowing that the first thing he must do is to find if it is something he can put out quickly. Or possibly a few men in Camp 5 right nearby can put it out before it gets headway. At the start a few men can very often put a fire out, and if time is lost in going for more help the fire gains headway. Very often general alarms are given and, like the fable story of "wolf! wolf!" men hold back after coming to a few false alarms. And a few men at the start taken quickly to the scene of the fire are better than arousing the whole plantation, losing time in so doing, and having poor turnouts the next day.

But Manuel, on getting closer, finds that the fire is larger than it looked at first, and he must ride fast to give the alarm. He gets the night watchman at the mill, or the nearest telephone to let the "higher ups" know. Someone in authority should be on the plantation at all times, for we have other people's money tied up in our fields and property.

The fire being a bad one, the general fire whistle at the mill is blown. I have seen many fires that did not require a lot of men. Small blazes are very deceptive at night. The general alarm should be given only when those in authority investigate and find it necessary. Minor fires may require only a truckful of men, but, of course, I would not hesitate if conditions warrant in arousing the whole plantation.

Steam is kept on one locomotive at all times that labourers may get to the fire, and that the alarm may be blown in case the mill is not running. The warehouse men rush to the warehouse to get the knives, hoes, shovels and buckets. The reservoir men and ditchmen already have standing instructions to get water in the nearest ditch, for in the excitement someone may forget this first requisite. These men know the ditches that carry the water in the shortest route, and they must be trained to think of water first.

Manuel we leave with the other lunas in getting the men to the fire in trucks, autos, locomotive, on horseback, and on foot. The truck drivers know they must go to the camps to get the men who are already being aroused by the camp boss, and they must get their loads as quickly as possible, get to the fire, and then go back for more men. Their trucks are fully equipped with cane knives, as are all the locomotives, for a man must have some tool at a fire.

Fortunately, our fire has not gained much headway. The head overseer on reaching the fire sizes up the situation, where the firebreaks are to be, etc. Here the tendency is to get too close to the fire, making it impossible to do anything on account of the smoke, and making it more dangerous for the men. Also the backfire will then have no time to work back before the fire is upon it, and we have the whole thing to do over again. The fire jumps sometimes 300 ft., depending on the variety of cane, the wind, or the dryness of the field. May we digress here to the topic of *firebreaks*?

In choosing firebreaks, we must study the wind, its velocity and direction, the terrain, ditches, ridges, and roadways. A fire can be stopped on a ridge easier than in a hollow where the cane is heavier. It can be stopped in cane at the beginning of a season when the tops of the cane are green and there are no dry leaves to cause a jump. A small leaf like H 109 is better than a broad leaf like Yellow Caledonia. A recumbent cane is better than erect cane. A night fire is easier to watch for these flying leaves than a day fire. In studying the wind, one may find a way to almost change the wind around, by creating a draft from a backfire made in a certain direction. The flames may be made to go up as they would in a chimney. So it is important to pick the right firebreaks. Very often it may be best to start two firebreaks, working with the wind and pinching the fire. In this way, the men are in less danger and they are in fresh air, so that they can be called when the critical time comes, and not be exhausted. And, we repeat, do not cut the firebreak too close to the fire. Take plenty of room.

Having chosen our firebreak, the first essential is that the men know what to do. Here is where the "lunas" come in. One often sees a luna trying to put the whole fire out himself, having twenty of his men standing by, topping cane here and there, and not being directed. Men must be stationed to direct the others coming to the fire. Pick out the old men, the ones that are not so useful in the fire, to stay by the main road, the ditches, etc., to show the stragglers where they are to go, or where they are to get knives. These precautions avoid confusion. Much needless expenditure of energy occurs where there is no directing head in charge, or where different plans are being followed. Someone starts a backfire and then the work must be done all over again.

Backfires are very necessary at times, but they may be dangerous and men may be trapped. And backfires often jump. Gangs working on both sides of the fire, out of the smoke, and pinching the fire to some ridge or corner of the field can very often stop a fire without the danger of using backfires.' The first essential in fighting a fire is to think of *life*, and one should not send men into a fire where one would not go oneself, or where there is too much of a chance.

To go back to our fire. Our men know where to go and what to do. Our control means are firebreaks, backfires judiciously used, water, roads, ditches, green cane tops, shovels of earth, wet bags, and fire extinguishers. Green cane tops we place on the flames, keeping the flames down so that we may work the fire to a smaller head. In this connexion, there is nothing more effective than buckets of water, and here training helps. A man who has never thrown a bucket of water throws it in one place. Properly, it should be thrown in a fine spray in a motion similarly used by fishermen in casting a throw-net. The finer the spray, the more effective it seems, for the water covers a wider area, and those of us who have burned off know that a small sprinkle of rain will often put a fire out that had been going very well. This year, I have carried a half-dozen buckets in the back of my car, and on several occasions they have materially stopped cane fires. I also have cane knives there. And each harvesting field is equipped with a box containing chains, links, double-trees for the hauling, and cane knives, buckets and shovels for emergency use.

One never knows how a man will act in a fire. Some are nervous and make others nervous. I would rather have a gang of a few trained confident men on a fire than too many men that do not know what to do and get in each others way. Cane cutters who burn daily are the best at fires, but they will hang back unless proper leadership is shown. Even the directing head should occasionally jump in and spur the men on. But the leaders should prevent the men from crowding and thereby prevent accidents'

By hard work, then, our fire is out. We must be careful, right up to the end, for many a fire jumps at the last stretch when the fires from the two sides rush together. Or possibly we thought we had it out and had got too confident and had allowed a tiny flame to creep in some trash in the firebreak. We must leave men behind to see that no spark fans up or stump smoulders. At night, when the flames are out, we are glad that we had our flashlights with us, so that we can see that all the men get out. The timekeepers then see that the men have time allowed for their work at the fires, and we go home exhausted, but with more experience on cane fires, particularly in learning what *not* to do.

DETERIORATION.

Having had our cane fire, the questions always come up as to what we are going to lose; should we leave the cane standing or cut it all down as fast as we can ; and after how many days will it be fit for the mill, etc. ?

There are two reasons why I like to cut the cane down fast. One is that the men are keyed up to the fact that the plantation has had a fire and they will work harder. Next is that unless there is plenty of cane cut ahead, the track men cannot work, the loaders cannot load, the hauling is tied up and we do not get the cane into the mill at the greatest possible speed. Perhaps in wet weather it is better not to cut too far ahead for we must remember that we have two ends on a cut stalk for fermentation to work on, though inversion starts quickly from the top of the stalk anyway.

To quote from J. A. VERRET, who has collected deterioration figures from all the islands :—

"In regard to burning, the best figures we have are from the Ewa tests, on mature cane, in hot, dry weather, which figures are closely corroborated by many others on all the Islands.

The losses averaged about 3 per cent. a day, or, say 15 per cent. in five days. The loss on the first day is not so high. One thing to remember in this connexion is that this loss consists not only in the deterioration of the juice but also in loss of weight in cane. As your cane gets older, you are having losses even when your juices show no change. Our tests show that there is no advantage to allow burned cane to stand rather than to cut it."

With regular burning daily, we should have no old cane. At McBryde, we make small burns, and figures kept on a year's harvesting show that 14 per cent. of the cane reaches the mill within 12 hours from burning, 39 per cent. is 24 hours old, 36 per cent. is 48 hours old, and 10·5 per cent. is 72 hours old, or a total of 99·5 per cent. reaches the mill within 72 hours. The remainder, or one-half of 1 per cent., comes in within 96 hours and is cane sometimes held over Sunday, or because labour turn-outs were poor, or because the burn was misjudged as to tonnage.

PRECAUTIONS OR PREVENTION.

1. Our men should know what to do and where to go.
2. They should be trained in fire fighting, and there is no better way than to instruct them daily when burning off, that they may thereby gain confidence.
3. The field layouts should be studied and corrected, that we have no large fields of cane of the same age adjoining. We thereby lessen our fire hazard and possibly distribute our water better. Incidentally, we intensify our culture.
4. Have plenty of field roads and ditches. They should be laid out as firebreak aids. Water is the main requisite for most plantations. The land given up to roadways is not lost, for we have better aids to supervision and to the cutting of firelines in regular harvesting and emergency, especially where we have heavy cane and firebreak cutting is slow.
5. Have all roadways stripped of trash, grass or fire hazards.
6. Have a general understanding for truck drivers, ditchmen, lunas, etc., as to what they are to do.
7. Have tools handy, especially knives and buckets.
8. Fire extinguishers. Several places have a battery of fire extinguishers for fire fighting. Their value comes in keeping the flames down in critical places. They must be tested and kept filled regularly, for often some labourer turns one over and then, of course, it is of no further use. Take one out to a regular burn-off and show the lunas how it is to be used. The locomotives should carry them; so should the trucks. Hawi Plantation has a truck especially equipped with knives, extinguishers, chemical tank, buckets, and other fire apparatus.
9. The overhead system of irrigation lends itself to easy burning and to control of fires.
10. One good rule to try to follow is to burn off early in the morning, before the sun has a chance to dry the light dew off the leaves. The leaves will then be less apt to carry jump fires. Some plantations get night showers, making morning fires difficult, but it is well to remember that a day fire must be watched. The winds vary more in the day, when the sun is up, and we may then not have our regular night mountain or sea breeze.
11. In daily burning off, caution the men to be quiet, so that if the fire jumps a warning can be heard. Keep the men out of the smoke as much as possible, so that they are fresh in an emergency.
12. Beware of trash and grass fires, for many a gust of wind or creeping has started a cane fire.
13. Have the locomotive stacks inspected regularly; even oil burners start cane fires, possibly from some leaky pipe.
14. Cut the firebreaks to run as much as possible in the same direction as the wind.

According to official estimates, the Formosan sugar production for the 1925-26 season was, in June, expected to amount to 8,129,428 piculs (about 480,000 tons). This does not include brown sugars. The crop has not come up to anticipations owing to a prolonged drought in the south of the island.

Practical Methods of *pH* Measurement, and Scheme for Automatic Electrometric Control of Cane Juice Defecation.[1]

By R. T. BALCH and H. S. PAINE.
Carbohydrate Laboratory, Bureau of Chemistry, U.S. Dept. of Agriculture.

ELECTROMETRIC METHODS.

Measurement of electrometric hydrogen ion concentration depends upon the production of an electromotive force between a standard electrode (such as in a calomel half-cell) and some other type of electrode, the potential difference between the latter and the surrounding liquid being a function of the concentration of hydrogen ions in this liquid. The two electrodes are united by a saturated potassium chloride solution (salt bridge) and the potential difference between the two half-cells is measured by a potentiometer. From certain mathematical relationships which vary with the type of electrode and the temperature, the potentiometer readings may be calculated into terms of *pH* values.

The standard electrometric method employs the hydrogen electrode; its application to raw sugar-house products has been reported,[2] but only as a tool for the research chemist. There are many troublesome features connected with the method, so that one has to acquire considerable experience before he is able to operate it successfully.

On the other hand, the quinhydrone electrode[3] is rapidly gaining favour since it eliminates the objectionable features of the hydrogen electrode, and is in many respects the most ideal of any electrometric method yet developed. Like most methods, however, it has its limitations, which in this case are its unsuitability for measuring the *pH* of juices with *pH* greatly exceeding 7·0 and the error which results when applied to sulphured juices; but, since it is not customary to sulphur cane juice in manufacturing raw sugar, and since the error which results when the electrode is used in juice with a *pH* not exceeding 9·0 is of little consequence in controlling factory operation, provided the determinations are rapidly made and the first potentiometer reading is accepted as correct, these limitations do not constitute a serious objection to the use of the quinhydrone electrode in raw sugar manufacture. The quinhydrone electrode method is fully as rapid as the best of the colorimetric *pH* methods and equilibrium is very quickly established in most sugar factory liquors. Colour and turbidity are not in the least detrimental to the action of the quinhydrone electrode and, in addition, it is more sensitive than the colorimetric methods.

The quinhydrone electrode has been very satisfactorily used in this laboratory in several investigations, and interest has been aroused concerning its use in raw sugar factory laboratories for control of intermittent liming and in controlling inversion. A complete description of an apparatus that has been found to be very useful for this type of work, and directions for operating the same, will be given in another publication from this laboratory.[4]

CONTINUOUS ELECTROMETRIC *pH* MEASUREMENT.

In spite of the many advantages that the quinhydrone electrode possesses as a laboratory method for determining *pH* values, no satisfactory means have been developed for applying it to the continuous control of industrial processes. For this type of work the electrode should be simple, sturdy and self-contained, and should operate with little supervision. The "tungsten" electrode[1] appears to meet these conditions rather well, and it was therefore subjected to a number of tests. This device is really an oxygen electrode.[2] The type used in our tests consisted of a glass tube, which was coated at its lower end with manganese sesquioxide. Around the coating of sesquioxide was wound tungsten wire which terminated through a seal in the end of the glass tube. A mercury contact permitted a good junction with the lead to one terminal of the potentiometer. PARKER[1] has shown that this type of electrode functions well in alkaline solutions and follows rapidly the changes in *pH*; he also states that it seems probable that the tungsten-manganese sesquioxide electrode will not readily become "poisoned."

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[1] Condensed from *La. Planter*, 1925, **75**, No. 18, 347-350.

[2] BREWSTER and RAINES; *I S.J.*, 1922, **25**, 88; BOMONTI and MCALLEP: *Hawaiian Planters Record*, 1924, **28**, 120 and 559 COOK: *Sugar*, 1925, **27**, 211 and 264.

[3] BIILMAN: *Ann. Chim.*, 1920, **9**. 15, 109; 1921, **10**. 16, 321.

[4] DAWSON: "Measurement of the *pH* of Sugar House Products with the Quinhydrone Electrode," to be published soon. See also FARNELL: *I.S.J.*, 1925, **27**, 141. The apparatus described by this author is open to serious objection.

The limed juice was sampled at the exit from the juice-heaters (at which point the factory also made its control tests) and the clarified juice was tested between the scale tank and the evaporators.[3] In these experiments the apparatus consisted of a tungsten electrode, flowing type electrode vessel, calomel half-cell,[4] recording potentiometer,[4] and an arrangement for cooling the hot liquors.

The factory[5] at which these experiments were made used continuous liming in conjunction with the Petree-Dorr process,[6] the lime-delivering apparatus being operated from the first mill shaft. The lime suspension was added to the "primary" juice through a distributor placed crosswise to the juice trough below the strainer. Mixing of the juice and lime was accomplished by allowing the mixture to pass over baffles placed in the trough and to fall through a perforated plate into the storage tank from which it was pumped through two juice-heaters into the clarifier.

Portions of the record obtained on three successive days with limed juice leaving the heaters give a readily comprehensible picture of the rapid changes in juice reaction, and in itself should be valuable information to those in charge of factory operation. With a continuous chart before him at all times, the operator should be able to greatly improve the control of the liming operation.

INTERMITTENT LIMING WITH *pH* RECORDER.

In the ordinary defecation system where intermittent liming is used, the operation may be conducted in much the same way as at present, with the exception that the desired end-point is determined on the basis of the *pH* indication on the chart of the continuous recorder. A record of the reaction of each tank of juice passed into circulation will be quickly available also to those in charge of factory operation. This scheme is sketched in Fig. 1.

One continuous cell may serve two liming tanks, the juice from each being, of course, tested separately. The indicated apparatus consists of a recording potentiometer, a saturated KCl-calomel electrode, a salt bridge, a continuous flow electrode chamber, a tungsten or similar type of electrode, and a small centrifugal pump. The latter is quite important since the juice contains so much suspended material that it is practically impossible to obtain free circulation through the small pipes or valves which would be required for controlling the rate of flow by gravity.

Precaution against fermentation is as important as in sampling juice for laboratory analysis, for when fermentation once begins its development is rapid and in this case affects the *pH* measurement by causing a "poisoning" of the electrode (slow reaction) while, in addition the formation of acid-reacting substances, actually changes the *pH* value of the juice. Temperature variations exceeding 1 to 2° Centigrade should not be permitted, since the relationship between the *pH* and the potentiometer values is thereby changed. In other words, samples of juice having equal *pH* values will not produce the same potentiometer reading unless the temperature of each is the same. If such is not the case, it is necessary to introduce a cooling coil in the juice line between the liming tank and the electrode vessel.

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[1] PARKER: *Ind. Eng. Chem.*, 1925, 17, 737.

[2] Cf U S. Patent, No. 1,513,558 (1924).

[3] In operating the Petree-Dorr Process the defecated instead of raw juice is weighed.

[4] PARKER: *Ibid*

[5] Appreciative acknowledgment is made of the many courtesies extended by Sucesion J. Serrailles, Central Mercedita, Ponce, P. R.

[6] HARTMANN: *Ind. Eng. Chem*, 1924, 16. 178,

The recording potentiometer may be placed at any distance from the electrodes, connexion being made with copper wire cord. Either a "single point" potentiometer for tracing a continuous line from one circuit or a "multiple point" potentiometer for the simultaneous measuring and recording of *pH* from several circuits is available and may be used. The latter type is required if two or more tanks of juice are to be tested at the same time and is desirable when the equipment consists of more than two liming tanks.

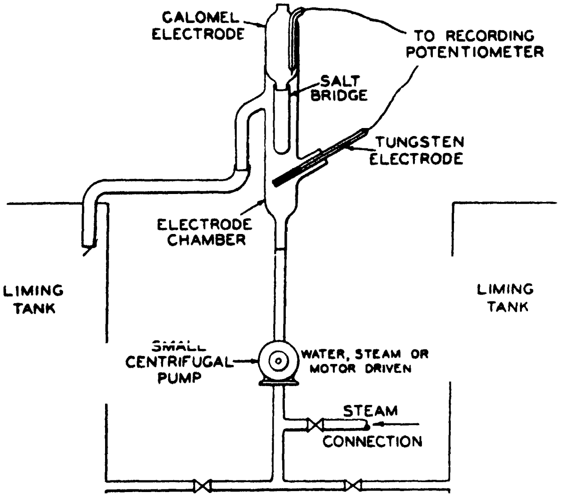

FIG. 1.
pH CONTROL OF INTERMITTENT LIMING.

Using such a system of control as has been described, the procedure of liming and testing would be essentially as follows: Addition of lime to the juice would be conducted in the customary manner, and after thorough mixing or just previous to that point, circulation of the juice would be started through the cell. If when equilibrium is established (as shown by the constancy of the potentiometer reading corresponding to that circuit) the reading did not coincide with a predetermined value, additional lime or juice would be added to obtain the desired reading. With experience the operator would be able to judge very accurately the quantity of either juice or lime required to give the desired potentiometer reading. The potentiometer readings are usually given in terms of volts as the instrument really measures electromotive force, and in practice it would not be necessary for the operator to calculate them in terms of *pH* values. After 12 hours of operation the chemist or qualified assistant would attend to the changing of the electrode vessel and tungsten electrode, and at the same time sterilize the pipe connexions and pump with steam. Since, when it is first brought into contact with the juice, the tungsten electrode requires from 20 to 30 mins. to reach equilibrium even when it has been previously kept moist, it may be desirable to assemble the replacement electrode and electrode vessel and partially fill with limed juice about a half hour previous to its use at the liming station. If the electrode is not again exposed to air it should function properly at once, thereby avoiding any error in the first measurements.

Continuous Liming with *pH* Recorder.

The *pH*-measuring apparatus required with continuous liming is the same as was described for use with intermittent liming. In order to secure as intimate mixing of the juice and lime as possible prior to determining the *pH*, the test may be made on juice leaving the heaters and preferably at the flash tank, since the juice at this point is at atmospheric pressure. A small centrifugal pump is used to circulate the juice. A scheme for the *pH* control of continuously limed juice is sketched in Fig. 2.

With continuous liming and continuous recording of the *pH* the control consists of adjusting the lime feed so as to obtain a constant potentiometer reading and one that corresponds to the desired *pH* value. The recording instrument may be located at any place, with respect to the liming station, which is convenient for the operator.

Many of the difficulties pertaining to the measurement of hydrogen ion concentration electrometrically have been eliminated in the apparatus above described but, like any scientific instrument, it must be respected as such and be given the care and attention required. The operation of the apparatus has, however, been simplified to such an extent that it is felt that the factory chemist should be competent to care for and successfully operate it. The cost of such an apparatus should be of minor importance if it proves to be as valuable in raw sugar manufacture as is believed possible in obtaining uniform juice liming based on scientifically correct principles which should result in better clarified juices, easier working massecuites and an improved grade of sugar. Industries generally are adopting and encouraging the development of many types of control instruments for which need has been felt, so the development of an automatic control for the most important step in raw sugar manufacture is certainly pertinent at this time.

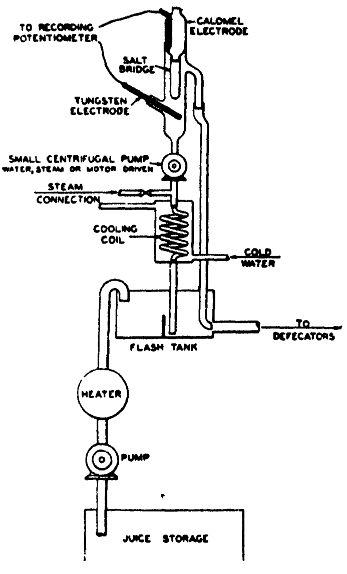

Fig. 2.

pH Control of Continuous Liming.

At present the recording potentiometer may be made to record from one to a number of circuits simultaneously, to operate such signals as warning lights or bells when the reaction does not fall within the desired limits, and, in proportion to the change in potentiometer readings, it may be made to operate an electro-magnetic valve which controls the rate of lime addition. There remains, then, only the actual application of this or similar equipment to the liming of cane juice. The control would be based upon the *pH* of the juice, and in the final form of development lime addition would be controlled automatically without the attention of an operator. This involves some engineering aspects which are beyond the scope of this paper, but which should not be difficult of solution in view of the basic conditions which have already been established.

Liming, Heating and Settling Practice in T. H.[1]

By WALTER E. SMITH.

LIMING.

The most serious irregularities of liming appear to exist where there is only one receiving tank below the scale, in which the lime mixing is done while juice is being constantly pumped out, and to which quite over-limed press juice is being returned. As this receiving tank empties, just prior to the discharge of a new scale of juice, the alkalinity of the limed juice may be very high due to the large percentage of press juice. When the scale is discharged, the lime measuring tank is emptied simultaneously, and usually the entire amount of lime has been added, while probably less than 10 per cent. of the juice has been discharged from the scale. Thus, the first portion of juice pumped to the heaters is distinctly over-limed, gradually decreasing in alkalinity until the scale is completely emptied, when the alkalinity again begins to increase toward the peak reaction. With the constant change in alkalinity of the limed juice, at only one brief period is the reaction equal to the average; and, as a result, it is practically impossible to estimate the actual lime requirements by tests of the cold limed or heated juice proper. The only indication is the reaction of the clarified juice at the time of drawing off, and this, of course, is quite inadequate for purposes of control.

This condition, however, can be easily remedied without recourse to the installation of extra tanks or changed liming systems. By a little experimenting the opening in the bottom of the lime measuring tank can be so regulated that practically the same length of time is required for emptying as for the discharge of the scale. If the lime is mixed with the juice immediately below the scale discharge valve, a rather thorough mixing will result, though it is well to supplement this mixing with agitation by compressed air. With such an arrangement the writer has succeeded in regulating liming so that the uniformity of reaction left little to be desired. Where press juice is returned to the mixed juice, this is very satisfactorily handled by installing a receiver of small diam. (10–12 in.) extending in height to the upper level of the receiving tank in the line to the raw juice pump. If the press juice is pumped to this receiver it will mix with the limed juice at a uniform rate and will be equally distributed, thus avoiding irregularities of reaction.

An arrangement having two mixing tanks with one scale, or three mixing tanks for two scales, gives a more flexible and more positive arrangement for the control of liming. Here the lime is added to a fixed quantity of juice, mixing is completed and the action tested before the juice is pumped to the heaters. Once the alkalinity is adjusted the entire contents of the tank may be depended on to be the same. Press juice may be disposed of in the same way as previously described.

One further system is the use of continuous liming devices such as the Fleener arrangement,[2] or that used in connexion with the Petree-Dorr process.

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[1] Extracted from Reports of the Association of Hawaiian Sugar Technologists, October, 1925.

[2] *I.S.J.*, 1925, 228.

With intelligent supervision the continuous installations work entirely satisfactorily, but in the smaller factories, where operation is likely to depend on unskilled labourers for considerable periods, intermittent liming seems less likely to result in operating difficulties occasioned by serious over- or under-liming.

HEATING.

Juice heating presents no problem of special difficulty; since with sufficient heating surface and suitable steam pressure, the juice temperature should be readily controlled. Difficulties may usually be traced to one of four sources: Improper discharge of condensate, incomplete venting of non-condensible gases, improper cleaning, or throttling between the exhaust mains and the steam chest of the heater. Proper functioning of traps is a mechanical detail that may be readily adjusted. Equal care should be given to the proper venting of incondensible gases, especially where heating is done with vapour from a pre-evaporator; where vapour heating is practised provision should be made to prevent air being drawn into the steam chamber of the heaters in the event that the vapour pressure falls below atmosphere, which is readily accomplished by the use of check valves on the vent lines. At one factory the work of the heaters was greatly improved by venting the incondensible gases under vacuum. In this case the vents were connected to the third effect, rendering the work of the heaters automatic and regular, the temperature of the juice varying with the pressure of the steam applied at the calandrias of the pre-evaporator cells.

If the juice is heated to or beyond the boiling point it should be given opportunity to flash before entering the settling tanks, which seems to break up the foam and scum which otherwise would float on the surface of the juice in the settlers. A number of factories are equipped with a so-called "pre-settler," which acts as a combination flash tank and supply tank. On flashing into this pre-settler, such foam as is produced will rise to the top, and since the juice is drawn off from the bottom no floating scum will be carried over. When this scum breaks up and sinks of its own accord, it is in a state in which it will likewise sink in the settling tanks.

SETTLING AND DECANTATION.

Maintaining clarification at the optimum reaction of *pH* 8·0–8·3 (as is being done in T. H.) brings with it the specific problem of an increased volume of settlings. Laboratory tests and actual observations under operating conditions have well demonstrated that the volume of settlings increases progressively with the H.I.C. of the juice, reaching its maximum in most cases at a point somewhat alkaline to phenolphthalein. This becomes a limiting factor of the reaction at which clarification may be conducted if there is not available sufficient capacity at the filters to compensate for the increased duty imposed on that station.

Many operators interpret the conditions which exist when clarification is maintained at the optimum reaction as "slow settling," but the condition is not actually one of slow settling, but simply one of increased volume of settlings, the precipitate coming to rest and settling to its ultimate volume in approximately the same time required for settling at a less alkaline reaction. Mr. W. R. McAllep has prepared a graph from data furnished by Nöel Deerr,[1] which fully demonstrates this point. These curves indicate that during the first part of the settling cycle the precipitate follows the physical law pertaining to the fall of bodies through a resistant medium, the graph being practically a straight line until it reaches a so-called "critical point" after which the shrinking or contraction of the volume of settlings becomes quite small and of little practical significance. These data, confirmed by actual observation of the conditions in question under operating conditions, indicate quite clearly that the solution of the question of increased volume of settlings must be approached on the basis of actual disposal by filtration rather than attempting to reduce this volume by extended settling to equal that obtained with less alkaline clarification.

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[1] Nöel Deerr: "Cane Sugar" (Norman Rodger, London).

Once the precipitate settles to the critical point no material reduction in volume will follow: and certainly this reduction will not be proportionate to the extension of time. If sufficient capacity exists to permit holding the juice an hour-and-a-half this should be sufficient to bring the volumes of settlings to a practical working minimum. Indeed, considerations based on the development of acidity and inversion at the high temperatures normally existing in the settling tanks would indicate that the cycle should not be lengthened much beyond this limit. It would seem more economical, and certainly more consistent with the principles of efficient operation, to provide the remedy by increasing the capacity of the filter-station.

A factor of considerable importance as affecting the settling cycle is the disposal of filter-press juice. When working with cane juices high in phosphoric acid, at the optimum reaction the volume of filter-press juice is likely to amount to fully 20 per cent. of the mixed juice. Obviously, if this is taken back to the raw juice for re-settling, the duty imposed on the equipment is increased 20–25 per cent., thus reducing the settling cycle by that amount. The practice of returning the filter-press juice to the raw juice is defended principally on the ground that this is a safeguard against contaminating the clarified juice through broken filter cloths. But the real solution must be to so organize the work of the filter-press station that it can be depended on to deliver clean juice at all times without danger of allowing dirty juice to re-enter the system. Probably half of the factories now do so in an entirely satisfactory manner, which is ample proof that the scheme is entirely feasible.

The principal objection which may be aimed at the intermittent settling tank is the fact that a considerable portion of the total juice must be decanted from a zone immediately over the mud line. This disadvantage makes itself evident in many ways. Frequently the juice discharged from the lower draw-off is not so clear as that from the upper valves, due to the fact that the currents set up immediately over the mud line carry over just sufficient mud particles to make the juice turbid, but not sufficient to warrant turning this juice to the mud trough. This disturbance becomes more exaggerated if the rate of draw-off is increased, and to prevent this the tendency is to draw off more slowly from the lower valve than is actually necessary, resulting in a reduction in the efficiency of utilization of settling capacity. In some cases, the writer has seen a third of the total settling tanks in a factory practically out of service because of the slow rate of draw-off from the lower outlets.

Conversely, the principal advantage of the continuous type of settling tank lies in the fact that the juice is drawn off at the maximum distance from the mud line. Despite this fact, however, several installations of continuous settling tanks fail absolutely to deliver juice of equal clarity to that which might be expected from similar clarification procedure with intermittent tanks. In one particular installation with which the writer experimented, both intermittent and continuous settlers were supplied with heated lime juice from a common supply tank, when the intermittent tanks never failed to give juice of superior clarity.

With intermittent settling tanks of convenient design, when clarification is carried at even moderate alkalinity, the level of the mud will in almost every case lie between the lower and middle outlets. Many factories follow the practice of drawing off mud through the lower draw-off until clear juice is discharged from this valve, at which time the juice is diverted to the clear juice trough.

The result of this rapid draw-off must certainly be to set up currents within the tank which result in drawing off with the mud a considerable volume of clear juice as well. Much better results should follow if the heavy mud is drawn out through the mud discharge valve, thus lowering the level of the mud line below the lower outlet valve. Since in this way the movement of the juice and mud is in a downward direction, no disturbance should result. If mud to be filtered is drawn only from the bottom valve, the mud or dirty juice trough may be connected to the limed juice receiving tank; the only juice then turned to this trough would be that first drawn off from each valve, and the juice from the lower outlet in the event that it ran dirty through too rapid discharge. By diverting this juice to the mixed juice for re-settling, the duty on the filters may be considerably lightened and the ratio of solids to liquid in the settlings may be maintained at a higher figure.

Clarification on Single Shift.

In factories which operate 12 hours per day, losses during the 12-hour hold-over period may reach serious proportions. Due first to the development of acidity through heat; or second, through bacterial activity.

At 210°F., the development of acidity proceeds at approximately four times the rate found at 180°F., so that for juices to be held over-night, the obvious procedure is to reduce the temperature to the limit imposed by other operating considerations. Complete coagulation of proteids is best secured by heating to a minimum at 180°F.; on the other hand, 165°F., has been set as the safe lower limit to prevent the activity of bacteria and organisms which are found in cane juices.

With juice to be held over the week-end for a period of 36 hours, if the temperature loss by radiation is three-quarters of a degree per hour, the initial temperature must not be less than 192°F., and with a suitable factor of safety the heating would ordinarily be carried at 200°F. At this temperature, however, the development of acidity would proceed at such a rate that juice limed to the optimum reaction of 8·0—8·3 would no doubt have a final reaction low enough to cause appreciable loss through inversion. If, on the other hand, the insulation of the settling tanks was such as to reduce the temperature loss to one-third of a degree per hour, an initial temperature of 185° would be sufficient to assure a final temperature above the bacterial danger point, and at this temperature the final reaction would be such as to exclude the liability of appreciable inversion.

At the factory of Hawaiian Agricultural Company, the tanks are insulated on the sides with the customary 1½ in. magnesia blocks, and in addition the bottom cone is now covered with a 2 in. layer of asbestos cement, with the top completely sealed in with a similar covering. Initial and final temperatures average 186 and 168°F., a drop therefore of 18·0, while the *pH* remains at about *pH* 8·0. Under these conditions the possibility of loss by inversion is negligible as a practical operating factor.

For factories operating one shift, to equip each settling tank with an individual thermometer is one of the best investments that could be made. This gives the operator a chance to know definitely what is being done, a basis for judging the effectiveness of the insulation, and constitutes a control on the accuracy with which the over-all plan is being followed. Measurement of *pH* values on each individual tank of juice held over will in many cases throw a good deal of light on the source of undetermined losses and will effectively demonstrate the necessity of exact temperature and reaction control. A factory operator who fails to take advantage of this opportunity to put the control of juice preservation conditions on a scientific and reliable basis is not availing himself of what is without doubt the most important development in sugar factory control made within a considerable period. As a result of a great deal of experimental work it can be said with certainty that if the reaction of the juice is maintained at or above *pH* 7·5 inversion will not occur. None but an intelligent man should be permitted to have charge of the liming.

Insulation becomes a matter of vital importance, especially in factories which are obliged to hold juice over for some twelve hours out of each day. An effective and economical way of insulating the bottoms of the tanks is to enclose the entire area with "Celotex," though a layer of asbestos on the cone would probably be well justified. For the tops a 2–3 in. layer of asbestos plaster is recommended. With efficient insulation the temperature drop should be less than 0·5°F. per hour, and a very material possibility for increase in recovery lies open to most of the smaller factories at very small cost by proceeding in this direction.

Improvements in Cane Milling Equipment.[1]

By DAVID R. BOWEN.
Chief Engineer, Farrel Foundry and Machine Company.

In a recent article discussing Possible Improvements in the Milling of Cane[2] Mr. HUBERT EDSON calls attention to a general lack of efficiency in milling equipment and practice, particularly the lack of flexibility in the speed of milling units and low efficiency in the methods of applying maceration. He also raised the question of the utilization of shredding to reduce crushing requirements and to increase extraction.

The purpose of this reply is not to controvert any of Mr. EDSON's statements, with which the writer is in hearty accord, but to show that while the problems mentioned by Mr. EDSON may be unsolved so far as the general run of Cuban mills is concerned, they have received the attention of sugar engineers and machinery manufacturers with the result that satisfactory answers to the questions he propounds have been evolved.

The use of shredders.—Taking up, first, the matter of shredding there is, undoubtedly, a fairly widespread belief that a blanket of bagasse once formed by a crusher or mill should remain as nearly undisturbed as possible for subsequent millings. The motive back of this belief can easily be determined as one of capacity and not of extraction. With heavy milling, where this blanket is 8 in. or more in thickness, maceration, without which high extractions cannot be obtained, would be more effective if this blanket were disturbed and the component parts of it more finely divided so that the macerating liquid could be more intimately mixed with it.

It certainly is a more economical process to prepare the bagasse for proper maceration admixture immediately after the first crushing rather than have to wait for the action of two crushers and one mill, or one crusher and one mill, as has to be done with heavy milling when the bagasse blanket is undisturbed. There seems to be no material difficulty in recompressing a disturbed bagasse blanket so that it will feed into succeeding mills, and if the preparation of the bagasse for proper maceration is begun immediately after the crusher-shredder, increased extraction will be attained.

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[1] Reproduced from *Facts about Sugar*, XXI, 490.

[2] *I.S.J.*, 1926, 192.

Dr. FRANCOIS MAXWELL has met the objections raised against shredders on the score of their high speed and high power consumption in his patented crusher-shredder. This machine is a single shredding roll attached to crusher rolls and, because its action is of knife-like character, cutting and slitting the cane instead of hammering it, the production of fine bagacillo is reduced to a minimum and the rind of the cane is left in long fibres which facilitate its subsequent milling. The shredding roll is operated by an engine or motor independently of the crusher rolls so that its speed can be varied to meet conditions. Practice has shown that effective shredding action can be secured with this machine by speeds between 300 and 500 revs. per min. of the shredding roll.

Variable-speed mill drives.—As to the need for the provision of variable speeds for individual mills which Mr. EDSON brings out so clearly, a little consideration of the problems involved in the multiple milling of cane will inevitably lead to the conclusion that an individual drive for each milling unit is correct in principle. The first engine-driven installations for multiple milling followed this practice, and it is still largely continued in Java, where the excellence of milling compared to the strength and number of rolls in use is most apparent.

This individual engine drive was abandoned in those countries where the demand for large capacities became insistent because, with the increasing number of mills in the tandem necessary to secure a satisfactory extraction with the heavy grindings, motives of installation, operation and space economies forced the use of one engine to drive two or more mills.

With multiple mills driven by one engine the speed ratio of one mill to the other is fixed, whereas the rate of flow of bagasse through them is constantly changing due either to irregularities of cane carrier feed or to the fibre variations in the cane itself. This compels the setting and operation of the mills to take care of the maximum feed of cane presented in order to prevent chokes. As this maximum feed is presented only occasionally the mills are operating part of the time under slack conditions, which produce inferior results both in extraction and in fuel value of bagasse.

Direct current drive.—With the advent of electrically-driven mills there was a reversion to the old type of individual drives, but as alternating current has been used for this drive the desired flexibility of each milling unit has not been secured, since the speed of A.C. motors cannot be accelerated but only reduced. Power also is wasted in this speed reduction, as it is entirely absorbed in grid resistance. The only motive force that will meet the condition of easily controllable unit adjustability, so essential for efficiency in multiple milling, is D.C. electricity. Steel, rubber and paper mills which had similar conditions to meet, found this to be so, and the sugar industry will undoubtedly have to follow in their steps. Mr. E. H. THOMAS, present New York representative of the Farrel Foundry and Machine Company, first suggested this to the company and he, in conjunction with engineers of one of the leading motor manufacturers, has developed a power plant installation and motor control system that makes its first cost compare very favourably with the cost of a power plant using alternating current for driving the mills, and but very little more than for steam engine drive.

Recognizing the desirability of using alternating current for power purposes other than milling in a sugar factory, the power plant consists of A.C. and D.C. generators mounted on one shaft, both driven by one turbine. With this combination the full power of the A.C. generator is always available for the auxiliaries, since the speed of the turbine is not varied. This style of power plant is regularly built in commercial sizes for industries other than sugar and requires no experimental development. The power-house equipment other than the generating plant is also as simple with the combination of D.C. and A.C. generators as with the A.C. drive alone. And since equally high voltages can be used with both currents, the wiring costs from the switch-board to the mill motors are less with the D.C. drive.

The commutators of the D.C. mill motors are protected from dust abrasion by the use of standard totally enclosed motors, which are cooled by an air current derived from outside the mill room carried to them in conduits from an electrically operated blower, the motor of which is automatically started by any one of the mill motors.

The control panel for operating the entire train of mills is located on an elevated platform and is operated by one attendant who, through the main rheostat control, can change the speed of the whole milling plant or, through the rheostat control of each individual motor, can vary the speed of any one mill independently of the others. Thus a completely flexible plant, ideal for cane milling purposes, is secured and in attaining this flexibility no power or space wastage is entailed, a condition that neither a steam engine nor an A.C. motor-driven plant can attain. Stop buttons are provided at various points so that the whole mill can be stopped from any button location.

Detailed plans for fitting this installation into a general factory design show the floor space for the mill room at least 20 per cent. less than can be secured by any engine-driven plant and also show that no other type of mill drive will permit a grouping of machinery that will result in a more economically erected or operated factory than with the D.C. motor mill drive. It is therefore with complete confidence that we present this method of mill drive to the trade as the most efficient, reliable and simplest yet offered.

Generated gears.—Mr. Edson criticises the gearing used to deliver power from the prime movers to the mills, and says that it is surprising that mill manufacturers hold to obsolete types of gearing when self-oiled generated gears are available. Generated gears, it may be explained, are those in which the gear, while being cut, revolves in practically the same way as it does when in operation, the cutter acting in the same manner as the pinion. So far as concerns the company with which the writer is connected this criticism does not apply, because this company, after ample practical demonstration of the superiority of this type of gearing, has acquired exclusive American rights to Sykes' generated gears and the machines for making them.

Efficiencies in these gears run as high as 98 per cent., and they can be furnished with any number of reductions necessary for sugar mill work from engines running as low as 40 revs. per min. up to electric motors running as high as 750 revs. per min. In these motor drives the first and second reductions from the motor (depending upon whether high or low speed motors are used) have generated machine-cut double helical teeth and the main spurs have generated machine-cut straight teeth. Because this gearing is so accurately made it is not necessary to mount it on adjustable pillow blocks as is required with the present type of gearing, and it can be totally enclosed to protect it from the abrasive action caused by the collection of dust and bagacillo on the exposed oiled surfaces of the open gearing. Its oiling is also made entirely automatic, both on the tooth faces and in the journal boxes. This protection is so perfect that one charge of oil can be made to last the whole season, and the lubrication is so uniform that over a period of years there is very little or no loss in efficiency due to tooth wear.

Publications Received.

The "A.D.C.O." Patent Manure Process. (Adco, Ltd., Harpenden, Herts.) 1926. Free on application.

Something has already been said about this process[1] of converting waste materials of the farm or plantation (e.g., bagasse) into "synthetic farmyard manure," a process which was discovered by officials of the Rothamsted Experiment Station, and is now commercialized. It has been patented all over the world.[2] "Adco" in the form of a fine powder is bought from the Company, or their agents, this preparation consisting of strains of bacteria and suitable nutrients which, when added to straw, bagasse or like material, convert it into a product similar to dung. To convert 100 tons of straw into farmyard manure, including the cost of "Adco," labour, pumping water, etc., works out at 6s. 7d. per ton.

Root Disease of Sugar Cane in Louisiana. R. D. Hands. Department Circular, 366; U.S. Department of Agriculture (Superintendent of Documents, Washington, D.C., U.S.A.). 1926. Price: 5 cents.

Root disease is largely responsible for the seriously decreased yields in Louisiana. Mutilation by snails and animals is of primary importance, but the complexity of the problem is such that further study is necessary to more definitely determine the relationship of the several factors involved. As to methods of control, soil fumigation with paradichlorbenzene has demonstrated a decidedly preventive effect on both the mutilation and the rot, though the trouble ultimately will probably be controlled by the substitution of more disease-evading varieties by planting, e.g., several of the P.O.J. seedlings.

Distillation in Practice. C. Elliott, B.Sc., A.M.Inst.C.E. The Chemical Engineering Library. (Ernest Benn, Ltd., London.) 1926. Price: 6s.

This small book is offered as a companion volume to the same author's "Distillation Principles," recently noticed. It outlines the processes occurring on a fractionating column confined to two components only. It has a chapter on heat transfer (a mere sketch), two on distillation apparatus in general, and one in ethyl alcohol. Other chapters deal briefly with distillation plant in general, and some applications in technical practice.

Het Inversiegevaar van Zwaveligzuur in de Suikerfabricage. Dr. L. van der Heide. (H. J. Paris, Amsterdam.) 1926.

This is a doctorate dissertation on the danger of inversion by sulphurous acid in sugar manufacture. An account of its most interesting general points will be given later in the *Journal.*

Maple Products. Publication No. 35 (Department of Health, Ottawa, Canada). 1926.

This 6-page leaflet covers: the Maple Products Act and the trade; the improvement of the maple industry in Canada; and summary of samples analysed, prosecutions, and seizures.

British Chemicals: Their Manufacturers and Uses. (Ernest Benn, Limited, London). 1926. Price: 10s. 6d.

This is the Directory of the Association of British Chemical Manufacturers, the combined capital of the members of which amounts to about £150,000,000. Products are listed in English, French, Spanish, Italian, Portuguese, and German. It contains information on the commercial uses of chemicals, and should prove a compilation of some usefulness to all concerned with the chemical industry.

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[1] *I.S.J.*, 1924, 616. [2] See U.K. Patent, 219,384, taken out by Agricultural Developments Co. (Pyford), Ltd., and others; *I.S.J.*, 1924, 615.

[3] *I.S.J.*, 1925, 496.

Brevities.

Mr. E. C. Freeland, authority on alcohol motor fuel, *inter alia*, has accepted a position in the Industrial Department of W. R. Grace & Co , New York.

Lump sugar, taken every hour, is said to have been the only nourishment of Mrs. Clemington Carson, an American swimmer, while performing her recent feat of covering 20 miles from Dover to Ramsgate, in 6 hours 20 minutes.

Ethereal oil from the leaves of *Chavica Betle*, a plant indigenous to the East Indies, has been found to contain a phenol, known commercially as "Aseptosol," possessing very powerful bactericide properties.[1] It is obtainable as an oil solidifying at 15·2°C., and is regarded as a valuable antiseptic preparation.

In Germany beet leaves and beet tops are washed and then chopped up in a suitable machine before being fed to live stock, the advantages of this preparation, according to G. Wiegand,[2] being that the material keeps better when siloed in this divided state and is better eaten. Sometimes this material is previously dried.

Recent deaths in the sugar world include Ernest Kopke, of Honolulu, one of Hawaii's best known engineers, whose name has frequently appeared in our pages in connexion with Hawaiian technical reports, and who patented the Kopke centrifugal clarifier; and John D. Spreckels, the California capitalist and sugar refiner, who was the eldest of four sons of Claus Spreckels the German industrialist who went to San Francisco in 1856 and founded a sugar refinery there.

According to a D.O.T. Report the estimated production of sugar for 1924 in El Salvador was placed at 20,000 metric tons. The quantity actually exported last year was 5447 tons, mostly to the United States, against 9224 tons exported in 1923. The year 1924 would appear to have been a bad one for sugar throughout Central America, exports in most cases dropping many points, but the slump in El Salvador, it is stated, was largely due to the abandonment of sugar by many planters in favour of cotton.

A type of concrete which contains rubber as the binding agent, and is consequently resistant against acids and sugar liquor has been put on the market. It is well suited for a number of purposes, as for constructing mill beds, juice gutters, storage tanks, fermentation tanks, receptacles for juice, syrup or molasses, and factory or warehouse flooring. It forms a cheap and efficient means of avoiding the solution of iron during manufacture or refining, and is easily applied. Moreover, this material is said to withstand a fair degree of heat.

Under the Sale of Food (Weights and Measures) Bill, recently made law in the United Kingdom, a number of different commodities retailed by shops and stores require to be sold by net weight. Sugar, which heretofore has almost generally been weighed with its wrapper, is listed amongst them. Articles sold in pre-packed form must be made up in quantities of 2, 4, 8, 12 and 16 ozs., or in multiples of 1 lb., and if not pre-packed it must be weighed in the customer's presence, or delivered with a legible statement of net weight This new regulation may now induce refiners, white beet sugar manufacturers, and distributors of yellow crystals, to put up their wares in distinctive cartons for the grocery trade in this country.

In Natal the question is being debated whether the granulated made locally by the carbonation process can be correctly described as a refined sugar. It is argued that as the British beet factories (excepting two which make raws) are using the carbonation process and sell their product as "refined," therefore cane carbonation granulated should have that classification. But this declaration appears to overlook the different nature of cane and beet juice, and it also ignores the opinion of Dr. H. C. Prinsen Geerligs, the foremost authority on the subject, when he stated[3]: "The very best white plantation sugar will always contain a very small amount of glucose, while granulated beet sugar, which has crystallized out of a syrup which did not contain any glucose, does not occlude a liquid which holds that constituent. . . . . In the great majority of cases this small admixture of glucose is perfectly harmless. . . . . the small amount present will not cause any trouble; but it does in some cases for confectionery," some preparations of which become sticky, whereas those made with refined sugar remain dry.

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[1] *Chemical Trade Journal*, 1926, 78, No. 2033, 560.

[2] *Zuckerrubenbau*, 1925, 7, 34.

[3] *I.S.J.*, 1919, 228.

In Guatemala the development of the sugar industry has suffered on account of the low world prices ruling for this commodity. But a new factory capable of producing 200,000 centals (10,000 short tons) of sugar has lately been erected by El Salto, Ltd., a British-controlled company.

Mr. GEORGE F. RENTON, Manager, Ewa Plantation Co., T. H., reports that for 1925 his average yield was 11·87 tons of sugar per acre, some of the area cultivated giving 15 tons at least, this mostly planted with H-109. His company made a profit of $1,152,872 on a crop of 50,822 tons of sugar.

Interesting cost data relative to beet growing in Utah show *inter alia* that the average cost per ton of roots for labour and material was $5·82 and including rent and interest $7·21; while the price received by the grower was $8·18, making his net profit per ton to be $2·36 without allowing for any return on the land and capital invested or $0 97 with these items included.[1]

At Sarina, Queensland, a huge molasses tank built of reinforced concrete, about 90 ft. in diam., 10 ft. high, and 2 ft. above ground has been erected, its walls being about 9 in. thick. Its capacity is 500,000 galls., and its interior surface has been treated so as to prevent the molasses eating into the cement. It is connected with the adjacent mill by pipe line, and its flumes join with tank cars on a distant siding.[2]

At the new Sarina power alcohol distillery the raw material is largely cassava, which has been widely planted throughout the district covered by the Plane Creek farms. This material is "cooked" at high pressure to rupture its starch grains, cooled, and treated according to the Boulard process of saccharification, using a special mucor. This distillery will be the last word in plants for the cheap and efficient production of alcohol.[3]

At the recent Peterborough Agricultural Show, a silver medal was awarded to the "Greyhound" Sugar Beet Harvester, for which it is claimed that it tops, lifts, cleans and heaps better than by hand and at less than one-sixth the cost. It severs uniformly and precisely the crown from the beet while the roots are still in the ground, then digs, lifts, and cleans them of dirt, and dumps in heaps. One man only operates the harvester and tractor.

Corrosion of concrete is stated by J. R. BAYLIS[4] to depend on the solubility of calcium carbonate (the principal binding constituent) which is determined by the hydrogen-ion concentration and salt content of the liquid coming into contact with it. A value of 200 parts per million for solubility of the $CaCO_3$ is an indication that disintegration is liable to occur rapidly. This is apart from the porosity of the material binding the larger aggregate, which is actually the controlling condition.

Dr. G. GROTE[5] explains that the tendency of liquid fuels to "knock" is directly connected with their physical properties, and particularly with their electrical insulating effects, the better the insulating action of the fuel, the greater its detonating tendency. Thus, benzine alone will knock, whereas a mixture of benzine, benzol, and alcohol that contains some water, not a very good insulator, will not. With this principle in view, a new fuel called "Gasin" is now being put on the market in Germany.

Colouring cement and concrete by means of pigments is unsatisfactory for most purposes unless the size of the particles of the latter is less than those of the former. But in the new process of C. J. GOODWIN and G. N. WHITE[6] a derivative of a suitable dye is added to the gauging water, which is well mixed with the cement and sand, oxidation meanwhile taking place so that when the material has set it has acquired the desired colour. This process is being applied in the building of concrete houses and warehouses; and it finds use particularly for internal walls and floors. It is also being used for roads. Organic colours thus incorporated with the cement or concrete, so that precipitation occurs on the particles composing the structure, are stated to be much more permanent than the general run of pigments, and to have a better appearance, especially in the case of tinted aggregates, which for many purposes are very attractive.

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[1] *Facts about Sugar*, 1926, 21, No 18, 425.
[2] *Australian Sugar Journal*, 1926, 566.
[3] *Australian Sugar Journal*, 1926, 17, No. 10, 616–617.
[4] *Proc Amer. Soc. Civ. Eng.*, 1926 52, 549-578.
[5] *Chemical Trade Journal*, 1926, 78, No. 2033, 560.
[6] *The Chemical Age*, May 1st, 1926.

Review of Current Technical Literature.[1]

WORKING UP SUGAR DAMAGED BY FIRE. *C. W. Ladd. Sugar, 1926, 28, No. 7, 307-309.*

Some time ago there occurred in the warehouse of one of the California beet sugar factories, a very disastrous fire, affecting some 90,000 bags of granulated. A certain amount of this sugar was recovered in saleable condition after screening and re-sacking; some was charred beyond recovery; but the remainder which was discoloured and damaged (water content, 3·62; and invert sugar 0 57 per cent.) was worked up in the factory in the following way:—A sugar melter was installed in the warehouse, where a liquor of about 20° Brix was prepared in continuous operation, and pumped over to the factory filters, after which it was limed and carbonated, also continuously. Following this, it was pumped through plate-and-frame presses, sulphured, filtered, evaporated to 60° Brix, re-sulphured, refiltered (the usual beet factory procedure), and then sent to the pan floor for boiling. Three grades of sugar were grained: firsts, which went into the bag as standard granulated; seconds, which went into the bag as "off-coloured white"; thirds, which were dropped into crystallizers and left for an average of 35 hours, after which they were spun off and, in some cases, went to the bag as off-coloured white, and in other cases were melted back with thick-juice and reboiled. Green and wash syrups spun off the firsts were used in boiling the seconds, and the green and wash from the seconds was used in boiling the thirds. In some instances, the low wash from the thirds was returned to the thirds, but most of it was allowed to go with the low molasses, which was pumped to an outside storage tank, the average purity of the final molasses being 67·85. Following is a brief resumé of production and costs: Sugar introduced, 5,595,580 lbs.; sugar produced, standard granulated, 4,160,500 lbs.; off-coloured white, 875,800 lbs. During these operations an apparatus was installed for washing the empty sugar bags, muslin and burlap, the wash-waters having a density of about 7° Brix being sent to the melter, but these bags could only be disposed of as "rags." Supplies and labour cost $749 and operating costs (fuel, light, limestone, coke, etc.) $34,196, a total of $34,990, the cost per bag working out at $0·684.

FORCED DRAUGHT AT PAMPANGA MILL, P.I. *J. B. Laing and E. W. Kopke. Sugar News, 1926, 7, 331.*

Natural draught conditions relative to the boiler, stack and furnace arrangement at Pampanga Mill, P.I, have imposed a limitation on the operating rate of the factory. In fact, for considerable periods it was impossible to realize full rating, and this condition applied a retarding influence on the capacity of the factory, particularly as to meeting the necessary steam demands in the boiling-house, and naturally imposed a rather close limitation on the amount of maceration which could be used at the mill The natural remedy appeared to be the installation of another boiler, particularly in view of the fact that this central has always accumulated a tremendous surplus of bagasse. In fact, when running at some 20 per cent. above rated capacity, its furnaces have operated on an actual consumption of fuel equivalent to 7¼ per cent. fibre in cane. However, under these conditions the fuel economy offered no attractions, as sufficient steam could not be generated, and the enormous amount of surplus bagasse being handled was a nuisance. As the purchase and installation of a boiler could not receive favourable consideration, especially due to the uncertainty of plans for the subsequent crop and the possibility of rearrangement of certain of the equipment, it was decided to install a blower and apply sufficient forced draught to boost the firing conditions. Inasmuch as the forced draught proposal involved somewhat of a departure in connexion with bagasse burning furnaces in this country, and in Hawaii, and as no accurate data were available as to the dependibility of the results, this installation was watched with considerable interest, especially because of the urgent need for more steam and the fact that failure to attain the desired results would have a serious influence on the harvesting of the 1925 crop. The blower fan purchased was of 10 ft. diam., direct driven by steam engine and mounted on the ground floor, outside and adjacent to the bagasse room. The original design of the ash pit was such as to readily permit the sealing of all openings other than the furnace ash doors below and back of the step-ladder grates. The usual stairs leading down into the ash pit from the mill floor and the run-away for conveying ashes out from the ash pit to the ground above were sealed by means of double doors, so that access to and from the ash-room could be made with freedom and without interrupting, to any significant extent, the draught conditions. Hence, the total amount of rearrangement in this connexion, that is, in order to practically seal the ash pit, was relatively simple and inexpensive. The capacity of the fan obtained for this purpose contemplated operations under ultimate capacity conditions and running far above normal boiler rating, and in order to conform with the operating conditions prevailing during the past season, it was only necessary to revolve the fan at a fraction of its full rate. Results obtained have been most gratifying. One of the important and desirable features which was observed as an immediate effect was the simplicity of control. A slight variation in the speed of the blower engine gives a practically immediate response in the firing rate and the steam generation. Remarkably uniform steam pressure has been maintained with the blower in operation, in fact a uniformity quite unattainable under the previous conditions has been realized. The boiling-house is now able to utilize steam with entire disregard for the limitations previously applying. Needless to say, this has been a tremendous relief. The greater steaming capacity attained through the use of this blower has naturally involved the consumption of a greater amount of fuel. But even so there is still a surplus of bagasse. Since the results attained through this installation have become known to a number of the sugar factory engineers and operators, the opinion has been expressed that a considerable number of plants would be substantially benefited through the greater range of control and wider steam generating capacity rendered available, particularly to meet peak boiling-house requirements which, in many instances, cannot be satisfactorily conformed with under natural draught conditions.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

RELIABILITY OF THE ELECTROMETRIC METHOD OF DETERMINING ASH IN RAW BEET SUGARS, IN COMPARISON WITH THE INCINERATION (SULPHATE) PROCESS.

L. Kayser. Zeitsch. Ver. deut. Zuckerind., 1926, 369-380.

In the Frankenthal beet sugar factory, Germany, about 150 samples of first and after-product raw beet sugars were examined by the author for their ash content by the electrical conductivity and incineration (sulphate) methods, the figures obtained being carefully compared. As the result of these determinations, he confirms the general conclusions arrived at by other chemists working along this line,[1] namely that the electrical method is not only much quicker (requiring only 10-12 mins.), but is more certain with the proper apparatus, and is cleaner, incineration with its attendant difficulties being abolished. Results are twice as easily reproducible, much less care being required. Only one weighing is necessary, and this only to 1 mgrm., as compared with three, two of them to 0·1 mgrm., in the chemical process. However, this investigator points out from his determinations that agreement between the two methods varies from factory to factory according to the type of raw beet sugar. Thus, in most of the samples examined, the agreement was very satisfactory, the differences between the electrical and the chemical methods (about 0·002 per cent.) never exceeding the limit of error in the latter. But some of the other samples showed much greater differences (0·01 to 0·02, and sometimes as high as 0·05 per cent.), so that the electrical method could only be used in comparison with the other by applying a correction obtained from the average differences between the two. Then, in a third and smaller proportion of the samples examined, mostly after-product raws, there were quite abnormal differences (0·05 to 0·15 per cent.), which could hardly be taken into account by applying such a method of adjustment. Regarding the reason for such variations, probably in most cases in which the result given by the electrical (*E*) is less than that given by the sulphate method (*S*), they are due to the insoluble ash included in the result given by the latter method ; but when, as happens, *E* is greater than *S*, some alteration in the composition of the mineral matter is the most likely reason that can at present be assigned. Lastly, this writer suggests there may be a connexion between the electrical conductivity and the total melassigenic substances in solution. If this were established, it would cause the electrical method to be considered as the standard means of determining the mineral matter in solution in sugar products.

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[1] *I.S.J.*, 1925, 503, 671 ; 1926, 136, 364.

PRODUCTION OF POWER ALCOHOL FROM BEETS. *Sir Robt. Robertson, D.Sc., F.R.S., Sir Joseph Petavel, F.R.S., and W. A. S. Calder, F.I.C. Report of Committee applied by the Ministry of Agriculture and Fisheries, London.*

As regards the cost of production of alcohol from sugar beet the Committee expresses the opinion that the cost of raw material referred to a gallon of alcohol, after allowing for the value of residual products, should be taken as 5 per cent. of the price per ton of beet, and that the manufacturing cost, that is the total cost of conversion, should be put at 9d. per gallon. On this basis, with sugar beet at £1 and £2 per ton respectively, the cost per gallon of 95 per cent. alcohol net naked at works would be 1s. 9d. and 2s. 9d. In addition there would be costs due to denaturation, packages, transport, and selling charges. For use in internal-combustion engines of present design the Committee state that one gallon of 95 per cent. alcohol is equivalent to less than three-quarters of a gallon of petrol. They think it possible that if the situation were skilfully handled from the commercial point of view, a market for a moderate quantity of fuel alcohol at approximately the same price as petrol might be secured. In answer to the question what quantity of alcohol should be regarded as equivalent to 1 cwt. of sugar, should the Government decide to accord some assistance to the industry, they state that the theoretical yield of 95 per cent. alcohol from 1 cwt. of sucrose is 8 gallons, and that 85 per cent. of this would be obtained in good practice, so that the practical yield would be 6·8 gallons per cwt. of sucrose.

Synthetic Processes.—One of the appendices to the report reviews various processes that have been proposed for the synthetic production of alcohol and of other liquid fuels. So far as the production of alcohol in this country is concerned, the Committee consider that the most hopeful processes not involving the distillation of fermented foodstuffs are those from water gas by leading steam over hot coke, and from wood by a method ensuring a high yield of fermentable sugar. These, however, are only in the experimental stage in this country and their economic possibility has to be proved. It is unlikely that any large amount of alcohol can be produced in the U.K. from ethylene, even though it could be removed from gas in conjunction with nitrogen fixation processes. As the production of carbide has been abandoned in this country as uneconomical, there seems little chance of spirit being derived from this source. It is too early yet to say whether liquid fuels (methyl and homologues) can be obtained from carbon monoxide and hydrogen by the Patart and similiar processes to compete with petrol. Production from wood does not appear to constitute a source of any considerable importance in the U.K. On the value of low-temperature carbonization of coal, and the Bergius process (heating coal in the presence of hydrogen to produce an oil similar to crude petroleum) it is not yet possible to pronounce an opinion, though such means appear to form the only way of producing supplies of oil in this country. Mr. BENJ. H. MORGAN discussed the general case of the British Power Alcohol Association, and gave some pertinent information. In particular he mentioned that the improved Classen process has realized a yield of 60 per cent. or 65 gallons per ton of wood, but only so far on the small scale.

DATA OF THE LA CARLOTA CENTRAL, P.I. *H. Gifford Stower. Communicated to this Journal by the La Carlota Sugar Central, Negros Occ., P. I., dated April 28th, 1926.*

Commencement of crop, November 30th, 1925 ; termination of crop, April 5th, 1926 ; possible working days, 103 ; days of 24 hours, 96 ; days of 24 hours worked, 91 ; average of hours per working day, 21·20 ; average hours for day of 24 hours, 22·53 ; time lost, due factory, 45·21 ; time lost, due to want of cane, 71·07 ; basic capacity of mills, 3000 tons ; milled, average for working day, 2779 tons ; milled, average for day of 24 hours, 2981 tons ; milled, average of 24 hours worked, 3145 tons ; sacks of 126·8 lbs. produced, average for working day, 6298; sacks of 126·8 lbs. produced, average for day of 24 hours, 6,757; sacks of 126·8 lbs. produced, average for each 24 hours worked, 7129; total sugar manufactured, sacks 126·8 lbs. net, 648,694; total sugar manufactured, 37,311 tons; total cane milled, 286,215 tons; average purity crusher juice, 86·86; fibre in cane, average, 10·98; tons of cane per ton of sugar, 7·67; acres cropped, 25,251; average tons of cane per acre, 11·33; average extraction in mills, 94·96.

Fuel Consumption in Different Countries in Cane Sugar Factories.

G. J. Schott. Archief, 1926, 34, No. 12, 327-328.

In the following tabulation the Java figures are taken from the 1924 official Mutual Control data; the Cuban are compiled by the Havana Sugar Club; the Queensland are those edited by the Bureau of Central Sugar Mills; and the Argentine are calculated from figures published in the *Industria Azucarera*:—

	Argentina.	Cuba.	Queensland.	Java.
Campaign	1924	1923-1924	1924	1924
Number of factories	35	79	6	163
Polarization of bagasse	—	3.96	4.50	3.64
Water in bagasse	—	49.39	53.50	46.30
Fuel value per kg. bagasse	1500	1950	1731	2117
Fibre, per cent. cane	—	10.72	12.89	12.89
Bagasse, per cent. cane	30	23.62	31.47	26.30
Calories in bagasse per kg. of cane	461	460	545	557
Calories in extra fuel per kg. cane	200	224	203	58
Calories used per kg. cane	661	685	748	615

In Argentina in the year concerned (1924) 3,500,000 tons of cane were ground with a yield of sugar of 250,000 tons or 7·14 per cent., the bagasse obtained being about 1,050,000 tons, or about 30 per cent. of the weight of cane, whilst about 250,000 tons of wood were used. Fuel value of the bagasse, about 1500 calories per kg., was due to its very high water content. The Cuban data take account of quantities of wood, oil and coal having fuel values of 3000, 10,000 and 6000 calories per kg. respectively. Of the six Queensland Government factories dealt with two are large and four small, the latter operating uneconomically.

Hydrogen Ion Concentration and Turbidity Methods in T. H. *W. K. Orth.*[1]

Reports of the Association of Hawaiian Sugar Technologists, October, 1925.

H.I C.:—Using clarified juice, for example, 4 separate drops are placed in four depressions of a porcelain test-plate; to one, 8 drops of distilled water (or better of M/5 potassium chloride) are added; and to the three others, 8 drops each of buffer solution covering the probable range, say *pH* 7·2 to 8·0 with stages of 0·2; then one drop of 0·04 per cent. phenol red solution are added, and the mixture stirred with a small glass rod, and compared. One of the buffered solutions will match the assay; or it may be intermediate between two of them, provided the range is correct. These buffer solutions are prepared according to the instructions of Clark and Lubs, but in concentration of M/2 instead of M/5, because the buffer action of mixed juice was found strong enough to throw the buffers off for a wide range, so that the *pH* determinations became indefinite. Indicators are made in concentrations of 0·10 per cent. and 0·5 per cent. instead of the 0·04 and 0·02 per cent. of Clark and Lubs, the reason being that then only one drop is needed. This method gave very satisfactory results, when the buffer solutions were re-standardized by a potentiometer, and is preferred to the colour chart procedure of the Experiment Station. Among the averaged results obtained at Ewa are the following: mixed juice, *pH* 8·18; clarified juice, 7·61; syrup, 7·51; *A* massecuite, 6·84; *A* molasses, 6·76; *B* massecuite, 6·76; *B* molasses, 6·77; second massecuite, 9·70; final molasses, 6·33. Mr. J. H. Pratt, Pioneer Mill Co., reported that it took two weeks to educate the men at the liming and settling tanks to the meaning and the importance of the H.I.C. determinations, but having done this the results obtained were immediately apparent.

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[1] Of Ewa Plantation, T. H.

One advantage is in testing the liming of tanks of juices held over during shut-downs, so as to keep them all at the same *pH* as when running steadily. Mr. F. D. Boltz, Hutchinson Sugar Co., gave the following average figures over May to August for clarified juice, press juice, and syrup, 7·09, 7·35 and 6·92 respectively. *Turbidity* :—By turbidity is meant a measure in degrees of millimeters, starting with zero and advancing to higher figures with greater clearness of liquid. It is estimated by means of the Kopke "turbidimeter" which consists of a small graduated glass tube, 0·3 cm. diam. and 6 cms. long, to the zero end of which is attached a white porcelain plate, 4 cms. in diam., and marked with fine black lines, forming 2 mm. squares. This plate is immersed in the juice until the black lines are just visible, the column of juice in the glass tube corresponding to this point then showing on its upper end the turbidity figure. Applying this procedure to clarified juice, press juice and syrup (diluted 1 : 5) the average turbidity figures from January to August were: 3·21, 3·93 and 2·19 respectively, variations being observed during this period in these values, according to the cane ground and other factors.

Reports on Drying, Densimetric, and Refractometric Methods of determining Water in Sugar Producrs containing Invert Sugar. Max Schneller. *Journal of the A.O.A.C.*, *1926*, *9*, *No. 2*, *156-165.*

Methods of determining water in sugar products, in which the sample is dried by heating, all suffer from the same faults, any agreement of results that may be obtained by collaborative workers being due merely to a compensation of errors, such as :—(1) Persistent moisture retention by film formation and high vapour tension of concentrated syrups , (2) Oxidation ; (3) Inversion of sucrose ; and (4) Decomposition of invert sugar, especially levulose, resulting in the formation of secondary condensation products—or even caramelization and splitting-off of water and volatile products. After previous attempts to improve the accuracy of drying methods with invert sugar, little hope was held out for a solution in this way. Determinations were made by vacuum drying at 70°C. with 40-60 mesh sand, but sufficient constancy of weight was not obtained even after a week's desiccation, though 30-36 hours gave a result fairly close to the densimetric reading. Distillation with toluene, using a modification of the Dean and Stark method[1] was found to have no advantage over drying, as it required as much time, and the end-point was by no means sharper. Then also an attempt was made to establish densimetric tables for invert sugar, but considerable irregularities were observed, though in general the refractometric solids were lower than the hydrometric solids by about 1·2 per cent., this being believed to be due (in part at least) to the formation during inversion of secondary or reversion products formed in the presence of the very small amount of acid used. No such irregularity was observed, however, in the case of dextrose, since a solution gave a practically identical values when tested by the polariscope, the hydrometer, and the refractometer. Further work is therefore required on determining water in invert sugar.

Beet Cultivation. *Conference at the Cambridge School of Agriculture, March, 1926.* F. Raynes produced results of trials in Norfolk showing that, though nitrogen applied in large quantity does tend to depress slightly the sugar per cent. of the beet, it does not reduce the sugar produced per acre, and under present conditions 12-14 tons of roots with say 15 per cent pays better than 8-10 tons with perhaps about 18 per cent. Mr. Arthur Amos pointed out that the recommendation from abroad that the best results were obtained with very narrow rows was open to challenge under English conditions, the 14 in. row, for example, making horse work nearly impossible and adding very greatly both to the time and expense of cultivation. As to seed-rate, 10 lbs. per acre should be enough.—Determination of Water in Molasses, Syrups, etc. Theo. Markovits *La. Planter*, *1926*, *76*, *No. 6*, *90-91.* Results are tabulated showing the refractometric method gives the highest total solids, distillation with toluene, etc., the lowest, while the official A.O.A.C. method employing desiccation was intermediate. It is concluded it is impossible to determine the correct water content of these products by existing analytical methods, and the best that can be done is to ascertain the non-volatile solids with the greatest degree of accuracy possible.—USE OF SUPERHEATED STEAM IN EVAPORATION. ***Emile Saillard.*** *Circulaire hebdomadaire, No. 1945.* Experiments at the Marle beet factory, using superheated steam in the pre-evaporator, show the coefficient of transmission to be higher with superheated than with wet steam; the quantity of condensation water to be much lower; and the juice to be no more coloured. Under otherwise equal conditions the apparatus evaporated more water with superheated that with wet steam. But this conclusion must not be generalized.—DETERMINATION OF THE EFFECT OF DECOLORIZING CARBONS BY ASCERTAINING THEIR SURFACE TENSION, USING TRAUBE'S METHOD. ***F. Tödt.*** *Vereins-Zeitschrift, 1926, 253-272.* As has already been pointed out,[1] the effect of decolorizing carbon in respect of the removal of colloids is best controlled by measuring the surface tension, this being depressed as the amount of gums is increased. But instead of using Du Noüy's apparatus, which gives uncertain results, Traube's ' Stalagmometer," which is reliable and quantitative, suitable for use in sugar factory work, cheap and simple to operate, should be used. It consists in principle in obtaining the number of drops of the liquid under examination falling in a given time as compared with the figure observed for pure water.—DETERMINATION OF REDUCING SUGARS, USING PICRIC ACID. ***Franz Herzfeld.*** *Vereins-Zeitschrift, 1926, 273-292.* Instead of determining the amount of picric acid converted by the reducing sugars into picramic acid by means of a colorimeter, the extent of the change of colour is estimated in a polarization-photometer, the total light absorption curves of the two acids having been established, and tables giving the extinction coefficients for various sugars having been compiled. But for impure products, owing to the presence of disturbing substances, such tables are inapplicable, though it is possible to elaborate a method limiting the error largely. Both time of boiling and proportion of reagents strongly influence the results.—CUBE SUGAR PLANT AT CHALMETTE, LOUISIANA. ***Anon.*** *The Planter, 1926, 76, No. 18, 356.* The American Sugar Refinery Co.'s plant, Chalmette, La., has recently been equipped with the Adant cube sugar process, this addition being capable of turning out 200,000 lbs. of domino tablets weekly, and being provided for the production of individually wrapped tablets, used extensively by hotels, restaurants, and railroads. This process is said to be used by only one other plant in the U.S., viz., the Brooklyn plant of the same Company. Cost of the process is stated to amount to $500,000.—FALKINER CANE HARVESTER. ***Anon.*** *The Planter, 1926, 75, No. 23, 250-251.* An account (with illustrations) is given of this apparatus.[2]—USING MOLASSES FOR STOCK FOOD. ***Anon.*** *The Planter, 1926, 76, No. 14, 267.* This article describes the molasses fodders which have been proposed for use in France,[3] and in Guadeloupe, some of the mixings being made with peat, grains, potato pulp, cane, beet, or vegetables. It cites Dr. W. E. CROSS,[4] who has stated that the use of molasses permits a daily economy of 25-40 per cent. of the ordinary cost of the ration, the animals being in better condition than without this addition to their diet.—STEFFEN WASTE WATER. ***A. M. Alvarado, H. L. Olin and Ed. Bartow.*** *Sugar, 1926, 161-162.* Full analyses are given of beets from Colorado, California and Wisconsin. Water obtained after the extraction of sugar from the molasses by the Steffen lime process was found to contain 6·31 per cent. of potash (as K_2O); and 2·31 per cent. of nitrogen (as N). Traces only of oxalic, tartaric, malic, succinic and citric acids were identified in it. Glutamic acid leucine and betaine were found present, the latter in greatest amount.—WATER ECONOMY IN THE BEET SUGAR FACTORY. *Gazeta Cukrownicza. 1925, 33-34*; through *Deut. Zuckerind. 1925, 51, No. 6, 144-145.* Per cent. of the roots, the following are stated as the water consumptions: Diffusion, 230; beet washers, 100-150; beet flumes, 500-800; gas washer, 15-25; pump cooling, 25; condensation 280-420; boilers, 60-70; washing cloths, 10; a total of 1220-1730. Quantities recoverable for re-use are stated, and suggestions made for the best way of doing this.

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[1] *Journal A.O.A.C.*, 1925, 8, 295.

J. P. O.

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[1] *I.S.J.*, 1925, 1924, 315, 556; 1925, 147, 210.

[2] *Berichte*, 1911, 44, 556; *Biochem. Zeitsch.*, 1910, 24, 341.

[3] *I.S.J.*, 1926, 51.

[4] E. SAILLARD: "Betterave et Sucrerie de Betterave," Vol. II, p. 590.

[5] W. E. CROSS: *Revista de Tucumán*, 1925, 15, 129-145.

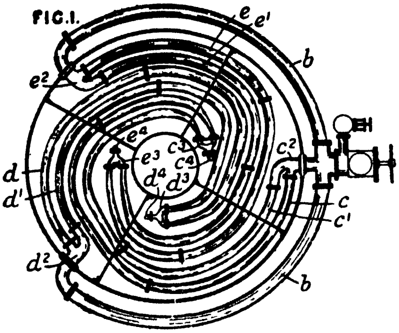
Review of Recent Patents.[1]

UNITED KINGDOM.

Heating System for Vacuum Pans, etc. *Blair, Campbell & McLean, Ltd., and Archibald Blair*, of Govan, Glasgow, Scotland. *248,897.* February 9th, 1925.

In one type of vacuum pan the heating system consists of a steam pipe in the form of a flat coil, its convolutions lying in the same plane and having the outer end connected to the main steam supply pipe, and the other or inner end to a discharge pipe through which condensed steam is withdrawn. In some cases two parallel coiled pipes are provided, these being coupled together at both ends, the couplings at the outer and inner ends of the pipes being connected to the steam supply pipe and the water or condensed steam discharge pipe respectively. With both of such constructions the maximum heating of the coil i only obtained where the pipe is coupled to the steam supply pipe. In vacuum pans and like vessels according to this invention the heating system comprises two or more pipes in the form of a coil or other desired formation the convolutions thereof being all in the same or substantially the same plane, each of the two or more pipes being independently connected to the steam supply pipe and each provided with a discharge outlet for the steam condensed therein. According to a preferred arrangement of carrying the invention into effect, the heating system comprises a plurality of pairs of pipes, three pairs for example, the pipes of each pair being parallel and slightly coiled. The inner end of each pair of pipes and also the outer ends are coupled together. The pairs of pipes are so constructed and located within the vacuum pan, or other vessel, that they do not overlap and that the outer coupled ends are located at regular spaced distances apart. The main steam supply pipe partially encircles the vessel, and the said outer couplings are each directly connected thereto, the inner coupled ends each being connected to a discharge pipe. By such construction the highly effective heat radiating area of the pipes in proximity to the steam inlets is greatly increased thereby enabling the heating of the vessel to be more quickly effected. Referring to the drawing :—a is the shell of the vacuum pan, and b is the steam supply pipe partly surrounding the vacuum pan. Located within the vacuum pan are three pairs of pipes, c, c^1, d, d^1, and e, e^1, each pair being in the form of a coil and so disposed that they do not overlap. The outer ends of each pair are joined to a coupling piece designated by the letters c^2, d^2 and e^2 and which are connected to the steam supply pipe b. The inner ends of each pair of tubes are also coupled together by couplings c^3 d^3 and e^3 which latter are connected by discharge pipes c^4, d^4 and e^4 to a discharge pipe common to all three, this latter not being shown. In operation steam is conducted from the steam supply pipe b to the outer ends of each of the three pairs of pipes, the condensed steam passing off through the pipes c^4, d^4 and e^4.

FIG. 1.



Production of Butyl Alcohol and Acetone from Carbohydrates (Molasses, etc.). *Commercial Solvents Corporation* (Assignees of *D. A. Legg*, of Terre Haute, Indiana, U.S.A.). *249,833.* February 25th, 1926; convention date, March 30th, 1925.

When fermenting molasses, glucose, "wood juice," and the like, poor in nitrogen, with the bacillus previously claimed for the purpose,[2] substances containing proteins (as the steep water from the production of maize starch) are added.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom :* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. 2 (price 1s. each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany :* Patentamt, Berlin, Germany.

[2] U.S. Patent, 1,315,585.

UNITED STATES.

PRESERVATION OF WHITE SUGAR AGAINST DETERIORATION BY MOULD FUNGI.[1] *William L. Owen*, of New Orleans, La., U.S.A. Dedicated to the People of the United States. *1,579,387*. April 6th, 1926.

Mould fungi are the causative agencies in the deterioration of sugars, but the inventor has found that if the molasses films surrounding the crystals are saturated with carbon dioxide gas the organisms are prevented from developing. He has further found that torulæ (non-sporulating yeast) have the ability of growing in the relatively high density of the molasses films. As, moreover, they form carbon dioxide, and do not attack sucrose, their activities may be utilized to great advantage in presenting the deterioration of sugar during storage. The process consists in the following steps: (*a*) The propagation of torulæ yeast forms in a special medium, under sterile conditions in a yeast apparatus. (*b*) The storage of this yeast in specially designed intermediate yeast storage tanks constructed as follows: The tanks are cylindrical in shape, and closed at the top so as to prevent the escape of the CO_2 from the filming molasses when it is discharged from the yeast apparatus. It is filled by a pipe from the apparatus, the pipe entering from the bottom, the discharge pipe to the daily supply tank, also leads from the bottom of the former tank. The capacity of the intermediate yeast tanks should be so designed that the supply of inoculated molasses required by the factory should be required by two of these tanks, sufficient margin being allowed so that one of the tanks can be thrown out of service at definite intervals for cleaning. As one of these tanks is emptied, the other is being inoculated from the apparatus, so that its contents may reach the desired condition of fermentation necessary for its use as filming material for the sugars. Where the size of the factory using this process would require such large quantities of filming material as to make the size of the tanks inconvenient if the entire capacity is divided between only two tanks, the installation should be doubled, tripled or quadrupled as the case may warrant. (*c*) The mixing of the yeast with molasses to obtain a spray material; the proportion of yeast to sugar is 1 : 10,000. (*d*) The spraying of this spray material in the desired quantities upon the sugars, after purging them in the centrifugal, i.e., after separating the crystals from the original mother-liquor. (*e*) The return of the excess of the yeast back into the process. The process is continuous, by reason of the fact that the amount of yeast developed at the different stages is always proportionate to the amount required for the daily output of sugar in the factory. The amount of inoculating material that has been found to give best results when used on sugars is 5 per cent., by weight, of a molasses having one million yeast cells per cubic centimetre. The special torulæ culture isolated for this purpose, on account of its fermentation efficiency, and its capacity to form large amounts of CO_2, is propagated in a specially designed yeast apparatus. After from one to two weeks, the contents of the large vessel of the apparatus is discharged into an intermediate yeast tank, of capacity sufficient to take care of the needs of the factory during the interval necessary to develop a second lot in the apparatus and in a second intermediate yeast tank. Sufficient inoculating material is left in the small vessel of the apparatus to inoculate the contents of the large vessel, after the discharge of the finished contents into the intermediate yeast tank. The yeast or inoculating medium, is next drawn from the intermediate yeast tank into a daily supply tank at the centrifugals, from which it is discharged under CO_2 pressure through a spray while the sugars are being purged in the centrifugals. After spinning the centrifugals for a few minutes the excess of the inoculating material is removed and is returned to the intermediate yeast tank for further use. The efficiency of the fermentation process at any stage is determined by the following conditions, viz. (1) number of torulæ present in the inoculating material from the yeast apparatus; (2) rate of growth of torulæ in the intermediate yeast vat; (3) per cent. of free CO_2 in the inoculating material; and (4) percentage CO_2 in the finished sugar. The increases in the polarization of sugars inoculated in the protective process (due to the fact that levulose is principally attacked by the torulæ) gave a net increase of between $3·00 and $4·00 per ton computed on the prices of raw sugar on the New York market. But in addition to giving much better keeping sugars, and sugars of better colour and less affinity for moisture, the process gives increased initial polarization at practically no expense. Since the molasses used for filming the crystals increases greatly in polarization due to the destruction of the levulose, and since the use of this molasses on the sugar imparts this increase in polarization to the original films, it can readily be seen that the increased polarization has been obtained at practically no cost whatever. As an example of this may be cited an experiment wherein a Cuban molasses increased in polarization eight degrees, and the sugar filmed with it by this process increased 1·4 degrees in polarization.

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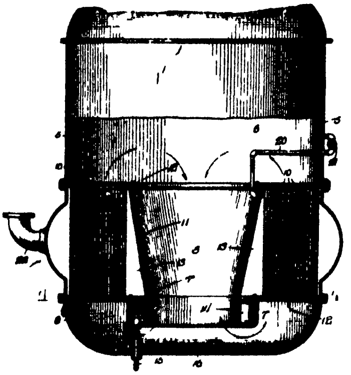
[1] See *I.S J.*, 1923, 371; 1926, 198.

Evaporator. *Martin J. Kermer*, of Evanston, Ill., U.S.A. *1,566,359.* December 22nd, 1925.

One of the objects of the invention is to increase the capacity efficiency of evaporators of the closed multi-effect type by providing an improved means for receiving its water of condensation and for the introduction of the water of condensation that comes from another evaporator. Another object is to provide means for accelerating the circulation of the heated liquid material to more readily absorb heat from the heating agency by utilizing the differences in temperature in the path of circulation of the heated material. In the structure here illustrated, the outer casing *5* contains an evaporating chamber comprising an upper chamber *6*, a lower chamber *7*, and a connecting down-take *8*, the latter extending through the deck *9* containing the bank of tubes *10*. The down-take tube is downwardly tapering, being considerably restricted at its lower end to accelerate the movement of liquid as it is about to enter the lower ends of the tubes *10*, which are in the path of circulation. The tubes *10* of the bank also connect the chambers *6* and *7*. The chamber or down-take *8* is surrounded by a relatively large tapered tube *11*, which extends below the lower wall *12* of the deck *9*. The deck *9* comprises the heating chamber bounded by the upper and lower crown plates *12*, and the portion of the outside casing *5* and the tapered tube *11* connecting said crown plates *12*. Between the tube *11* and the inner row of tubes *10* an annular space *13* extends. Below the space *13* is an annular trough *14* which constitutes a part of the invention. A pipe *15* passes through the wall *16* of the casing *5* into the trough *14* and on its upper end is secured a right angle elbow *17*. The heating water of condensation is introduced into the evaporator through the pipe *15*. The elbow *17* directs it into the circular path provided by the trough *14* in the direction shown by the arrows. Steam is immediately evolved from the heated water passing rapidly through the trough and rises into the space within the deck, contacting all of the exterior surfaces of the tubes *10*, and contributing to the heating effect of the steam already in this space. The water finds exit through a pipe. A partition in the trough *14* prevents the water from continuing its movement through the trough. The trough *14* also receives the water of condensation from the steam admitted through the steam pipe *22*. Air and some vapour is drawn from the interior of the deck through the pipe *20* by the same means that exhausts the chambers *6*, *7* and *8*. A valve *21* controls the attenuation of the fluid or vapour content of the evaporating chamber. After the hot water under pressure has made one circuit through the annular trough *14*, it will have given off all of the steam or vapour admissible, due to differences of pressure and, therefore, it may be quickly passed on to the evaporator of the next stage or effect. The temperature of the liquid within the tubes *10* is higher than that in the sub-chambers *6*, *7* and *8* and, therefore, the action of the water in the tubes is to rise into chamber *6*, whereupon, as a result of displacement, water will flow into the lower end of the tubes to take



the place of the hotter water that has flowed from their upper ends. The material contraction of the down-take tube *13* at its lower end will greatly accelerate the flow as it is about to enter the lower end of the tubes, thus by its momentum making a more active circulation and rapid interchange of the liquid undergoing evaporation.

Recovery of Sugar from Cane Molasses, using the Steffen Lime Process.

Howard S. Paine, Charles F. Walton, and Victor Birckner, of Oxon Hill, Maryland, U.S.A. Dedicated to the Citizens of the United States of America. *1,572,359.* February 9th, 1926.

De-sugarization of beet molasses has long been an established commercial practice, but when the same procedures have been applied to exhausted sugar cane molasses, that is, cane molasses from which all sucrose possible has been recovered by direct crystallization, the results have not been sufficiently satisfactory to justify the adoption of the process on a commercial scale. Very good evidence has been obtained that dextrose and levulose, and also the decomposition products of these sugars, interfere with the production of saccharate of suitable composition when attempting to de-sugarize sugar cane molasses. It has been known for some time that by selective fermentation of such sugars as dextrose and levulose, making use of micro-organisms substantially free from invertase, for example those of the *Pseudosaccharomyces apiculatus* group, sugars that are fermentable without the aid of invertase, for example dextrose and levulose, can be decomposed and thereby eliminated from sugar cane molasses, leaving the sucrose practically intact. In this process suitable members of the *P. apiculatus* group substantially free from invertase ferment the dextrose and levulose, leaving the sucrose virtually intact. After the fermentation has been completed, the well-known and established Steffen process for the formation of saccharate of lime, without substantial modifications, is applied. It was first proposed (U.S. Patent 751,990) to make use of this principle of selective fermentation to remove dextrose and levulose, employing members of the *P. apiculatus* group, and following the completion of the fermentation to concentrate the fermented liquor containing sucrose in a vacuum pan according to the customary sugar-house practice to obtain sucrose by direct crystallization. More recently an attempt has been made (U.S. Patent 1,401,433) to combine the idea of selective fermentation of dextrose and levulose with a modification of the saccharate process as ordinarily applied to the de-sugarization of beet molasses. We have found that it is not necessary to make use of any ethyl alcohol in connexion with the saccharate process as applied to the liquor resulting from the selective fermentation of sugar cane molasses. Ethyl alcohol is produced during fermentation, but this may be recovered before the application of the saccharate process, if desired, or it is possible to first make the saccharate and subsequently recover the products of fermentation. At all events, it is not necessary to make use of added ethyl alcohol in the manner recommended. Following which the saccharate is decomposed by carbon dioxide and the calcium carbonate separated from the sugar liquor, which is then evaporated in a vacuum pan in the customary manner to obtain sucrose by crystallization. This part of the procedure does not differ from well-known industrial practice as applied in the recovery of sucrose from beet molasses, and is not claimed as a part of the invention. In regard to details, the molasses is diluted to a density of 18° Brix and subjected to pure culture selective fermentation of invert sugar by suitable members of the *P. apiculatus* group. At the end of the fermentation period, the length of which will depend upon the size and vigour of the "starter" employed as well as on other conditions, but which has been found to require approximately four days, the invert sugar is very nearly completely fermented without substantial loss of sucrose, the ratio of invert sugar to sucrose after fermentation being approximately 1 to 6·5. The sucrose content of the fermented liquor is about 5 per cent., which is considered a satisfactory concentration, without either dilution or evaporation, for the next stage in the process, which is the production of calcium saccharate. Employing an experimental Steffen cooler of the same design as is commonly used on a large scale in the beet sugar industry, a charge of 14 litres of the fermented liquor containing [illegible] per cent. sucrose is taken. After cooling to a temperature of 10°C. powdered caustic lime is added in the proportion of 1¼ lime to 1 sucrose, the lime being slowly and automatically added over a period of 15 mins. The cold saccharate cake resulting after filtration is washed with 10 litres of water at a temperature of 15°C. and dried in vacuum. The cake is then suspended in water to a density of about 35° Brix, heated to 85°C., and carbonated to neutrality to phenolphthalein. The precipitated calcium carbonate is subsequently washed with a minimum of hot water to reduce its sucrose content to roughly 0·5 per cent. The products of the initial fermentation now contained in the combined filtrate, or waste, and the wash from the cold saccharate filtration are next obtained by distillation. Finally, the residue is heated to a temperature of 85°C. for 15 mins. to produce the maximum yield of hot saccharate, which is then filtered off and washed with a minimum of hot water to reduce the impurities contained therein without substantial loss of sucrose. If sufficient heat is applied during distillation, the hot saccharate is ready for filtration without additional heat treatment. A recovery of 77 per cent. of the sucrose was obtained in tests.

PRODUCTION OF ALCOHOL BY FERMENTATION. *Henry W. Dahlberg*, of Denver, Colo., U.S.A, *1,581,001*. April 13th, 1926. This patent specification gives a description of a process of manufacturing alcohol, which consists in fermenting a mash by yeast and beet extractive matter containing an organic nitrogen compound and including substantially all of the beet extractive matter of beet molasses, but substantially no commercially recoverable sugar.—ELIMINATION OF SCALE IN BOILERS, EVAPORATORS, ETC. *Karl Schnetzer*, of Aussig, Czecho-Slovakia. *1,581,024*. April 13th, 1926. The inventor protects his method of protecting metallic surfaces in contact with a body of fluid against formation and adhesion of scale thereon which comprises including the metallic surface in a metallic electric circuit, causing electric current to flow in the circuit so formed while maintaining across that part of the metallic surface that is included in the circuit a voltage below that which will cause appreciable electrolytic corrosion of the metallic surface beyond what would normally occur in the absence of the voltage, and thereby preventing the formation and adhesion of scale on the surface.—FERTILIZER MANUFACTURE. *Robert R. Hind*, of Del Carmen, P. I. *1,583,151*. May 4th, 1926. Molasses distillery lees is neutralized, concentrated by evaporation, and the concentrate mixed with bagasse.—TOPPING DEVICE FOR CANE HARVESTERS. *George D. Luce* (assignor to the *Luce Cane Harvester Corporation*, of New York, U.S.A.). *1,583,478*. May 4th, 1926. Claim 7:—In a machine of the character described, rearwardly and upwardly inclined conveyor chains for conveying the cane through the machine in a standing position, a frame above said chains, and means for adjustably supporting said frame for movement towards and from said chains, a topping cutter carried by said frame and mounted to rotate about an axis substantially perpendicular to the plane of the chains, and a topping fender carried by said frame and arranged substantially perpendicular to the plane of the chain and extending transversely above the line of travel of the conveying runs of the chains.—TOPPING DEVICE FOR SUGAR CANE HARVESTERS. *Frederick C. Douglas Wilkes and Francis K. Flynn* (assignors to the *Luce Cane Harvester Corporation*, of New York, U.S.A.). *1,583,510*. May 4th, 1926. Claim 1:—In a machine of the character described, conveying means for conveying the cane, a rotating topping cutter, and a fender having a side portion arranged transversely to the plane of the cutter and substantially parallel to the path of the conveying means, and having a top portion substantially parallel to the plane in which the cutter rotates.—BEET TOPPER. *John T. Pipe*, of Layton, Utah, U.S.A.). *1,583,796*. May 11th, 1926. Claim is made in a beet harvester for a frame mounted on wheels; a beet moving chain carried over sprocket wheels mounted on the frame; cross pieces on the chain longitudinally slotted to allow curved hooks to be operated therein; cross levers pivoted medially on the cross pieces; a curved hook on each of the cross levers adapted to operate in the slots of the cross pieces; and means to raise and lower the free ends of the levers as the chain is carried over the sprocket wheels, the means consisting of curved guide rods and pressure discs.—BRUSH PAN FOR CANE JUICE CLARIFICATION. *Charles L. Corne*, of Broussard, Lafayette, La., U.S.A. *1,563,254*. November 24th, 1925. This specification relates to a construction of a brush pan and evaporating pan for purifying and concentrating cane juice (presumably in small-scale production).—ANTI-FREEZING SOLUTION. *Edwin H. Crofoot*, of Mason City, Iowa, U.S.A. *1,581,179*. April 20th, 1926. An anti-freezing solution comprises waste liquor from sugar extraction processes. PREVENTION OF INCRUSTATION IN BOILERS, ETC. *Charles Prache*, of Paris, France. *1,581,545*. April 20th, 1926. An abrasive in comminuted form is introduced into the liquid circulating in boilers, and the like, for the prevention of incrustation.—CLARIFICATION OF BEET JUICE, USING PEPSIN. *Herman Schreiber*, of Lansing, Mich., U.S.A. *1,581,663*. April 20th, 1926. Diffusion juice is treated with pepsin in the presence of acid "until reaction has occurred," treated with milk-of-lime, carbonated, and filtered.—HOISTING AND WEIGHING APPARATUS FOR SUGAR CANE. *Gil A. Romero*, of Habana, Cuba. *1,581,873*. April 20th, 1926. Claim is made for means for weighing a cable suspended load, comprising a coiling drum for the cable suspending a load to be weighed, a scales, and a releasable operable connexion between the drum and the scales.—MULTIPLE EFFECT EVAPORATIVE SEPARATION. *Hugh K. Moore* (assignor to *Brown Company*, of Berlin, N.H., U.S.A.). *1,582,066—1,582,067*. April 27th, 1926. Liquor (presumably in apparatus containing more than four vessels) is caused to flow from an intermediate effect in sequence through a group of progressively hotter effects, and thence in sequence through a group of effects which are progressively colder.—COMPOSITION FOR REPRODUCING SIGNS, PRINTS, ETC. *William J. Gustin*, of Los Angeles, U.S.A. *1,582,136*. April 27th, 1926. Composition used for this purpose comprises sugar, carbolic acid, turpentine, and soap.—BEET TOPPING MACHINE. *James Mazzocco*, of Gallup, N. Mex. *1,582,292*, April 27th, 1926. A beet topping machine embodies a main frame, a vertically movable supplemental floating frame carried thereby, a device depending from and carried by the supplemental frame, a shaft vertically disposed and mounted for rotation in said device, means for rotating said shaft, a cutting element horizontally disposed on said shaft and means for yieldingly and adjustably supporting the supplemental frame to regulate the altitudinal position of the cutting element.—BEET PULLER. *John P. Seaholm* (assignor to *Deere & Co.*), of Moline, Ill. *1,584,996*. May 18th, 1926. Claim 1:—In a beet-puller, the combination with a frame, of downwardly-extending blade-carrying beams and means for mounting said beams on the frame, said beams being movable in said mounting means to effect both a transverse and a rocking longitudinal movement of the beams.—CLARIFIERS OR SETTLING TANKS. (*A*) *Ernest H. Richter*, of Seattle, Wash. *1,585,877*. May 25th, 1926. (*B*) *Benj. L. Harrison*, of Maplewood, Mo., U.S.A. *1,585,979*. May 25th, 1926. (*A*) Claim 1:—A clarifier comprising a vessel, a plurality of shelves, each of said shelves having a conduit, each of said conduits arranged to fit one within the other to form a continuous passageway, said conduits adapted to retain said shelves in superimposed spaced relation, means for supporting the lowermost shelf and its conduit above the bottom of the vessel, and means for connecting a syphon to the uppermost conduit. (*B*) Claim 1:—A liquid clarifier comprising a chamber for fluid solvent and a chamber for other lighter fluid thereabove, baffles in the solvent chamber and an inlet for the lighter fluid therebelow, a sump substantially separating said chambers, a passage connecting said chambers, and means for drawing off liquid from said upper chamber.—HIGHLY ACTIVE CHARCOAL IN THE FORM OF GRAINS. *H. Müller-Clemm and Erwin Schmidt* (assignors to *Gesellschaft für Chemische Produktion, G. m. b. H.*, of Mannheim-Waldhof, Germany). *1,586,106*. May 25th, 1926. 1:—A process for making highly active charcoal in grains which comprises granulating vegetable substances, impregnating the said granulated substances with potassium sulphide, and heating the impregnated material to incandescence with exclusion of air.—LIME KILN. *John T. Mabee* (assignor to *Raymond Bros. Engineering Co.*, of Chicago, Ill., U.S.A. *1,586,318*. Claim is made for the process of burning lime by the use of pulverized fuel, which comprises placing limestone in a stationary kiln, burning the fuel in a comparatively large separate combustion chamber so as to produce a large volume of mellow heat in the combustion chamber, and conducting the heated gases into the kiln and through the interstices between the broken limestone fragments held therein.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1926. Tons.	1925. Tons.
Total Receipts, January 1st to July 28th	2,168,683	2,232,770
Deliveries " "	1,962,869	2,103,624
Meltings by Refiners " "	1,914,000	2,014,930
Exports of Refined " "	60,000	157,000
Importers' Stocks, July 28th	214,470	129,146
Total Stocks, July 28th	317,617	230,197
	1925.	1924.
Total Consumption for twelve months	5,510,060	4,854,479

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924 Tons.	1925 Tons	1926 Tons.
Exports	2,505,959	3,063,394	2,489,408
Stocks	788,141	1,121,345	1,327,592
	3,294,100	4,184,739	3,817,000
Local Consumption	62,000	80,000	70,000
Receipts at Ports to June 30th	3,356,100	4,264,739	3,887,000

Havana, June 30th, 1926

J. GUMA.—L. MEJER

Sugar Crops of the World.

(Willett & Gray's Estimates to July 22nd, 1926.)

	1925-26. Tons.	1924-25. Tons.	1923-24. Tons.
CANE.			
America	8,621,699	8,878,451	7,419,141
Asia	6,125,360	5,565,390	5,909,840
Australasia	612,344	536,490	345,757
Africa	679,042	545,260	572,022
Europe	9,000	8,087	7,871
Total Cane	16,047,445	15,533,678	14,254,631
BEET.			
Europe	7,479,260	7,071,525	5,057,761
U.S.A.	804,439	974,185	787,217
Canada	32,475	36,200	16,500
Total Beet	8,316,174	8,081,910	5,861,478
TOTAL CANE AND BEET	**24,363,619**	**23,615,588**	**20,116,109**

United Kingdom Monthly Sugar Report.

Our last Report was dated the 9th July, 1926.

The market generally has been affected by the large stock of White Sugar in London and the continuance of imports from the Continent.

The liquidation of the August account kept the market depressed and the worst point was registered on the 3rd of August, on which day over 40,000 tons were tendered on the London Terminal Market, and August slumped to 13s. 3¾d. Tenders having found their way into stronger hands, the price, helped by a steadiness in the New York Futures Market, steadied again and at the time of writing is 13s. 7½d. Other months moved in sympathy, December was done down to 14s. 3d., March to 14s. 9¾d., and May at 15s. 1½d. To-day's prices are December 14s. 6¾d., March 15s. 0¾d., May 15s. 4½d.

Trade in actual sugar has continued slow, and the trade have focussed their attention more especially on the bulk of sugar stored in London, which—destined for tendering purposes—failed to pass the quality test, and while being thus unsuitable for pure grocery purposes provided a cheaper article for the manufacturers who—at this season of the year—are purchasing sugar for their boiling requirements. Sound Dutch and Czecho Granulated sugars have varied in price from 27s. 4½d. to 26s. 10½d. per cwt. during the month, with the out-of-condition quality at 6d. per cwt. less. F.O.B. sugars of the same marks have fetched a premium of as much as 1s. per cwt. over the London parity for shipment to other ports in the U.K.

Messrs. TATE & LYLE, LTD., made a new departure on the 19th July in offering their London Granulated, made from Empire raws, at 1s. per cwt. discount on their list price of 29s. less the usual allowances. This move was doubtless made to meet the competition of imported sugars which were freely offering in London at 27s. 3d. A good trade appears to have resulted and they disposed of a round quantity of this class of sugar which—in the ordinary way—is hampered in sale to the manufacturer on account of the duty drawback, and as a consequence of this trade they advanced their price by 3d. per cwt. the following week. Other grades remain unchanged.

Raws have remained practically unchanged, and business to this country continues somewhat slow in view of the lack of demand for Refined, together with the enhanced price of raw material consequent upon the extra freight charged due to the effects of the coal strike in this country.

The Board of Trade returns show a total consumption in the U.K. for the first six months of the year of 807,448 tons, which is slightly more than the corresponding period of last year. The stock of foreign refined sugar is steadily decreasing, while the total stock of sugars of all kinds has decreased by 50,000 tons during the month and is now gradually assuming more normal proportions, viz., 400,000 tons.

The crop in Cuba is now complete and the total stock in the Island appears to be about 2,180,000 tons, which represents an increase of 500,000 tons over last year.

Messrs. F. O. LICHT report an improvement in the crops in Europe, due to the recent better weather, and their revision of the sowings shows a slight decrease on their previous estimate amounting to 6,300 hectas. The total estimate for Europe being 1·3 per cent. increase on last year's sowings.

21, Mincing Lane,
London, E.C. 3.
August 9th, 1926.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

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☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 333. SEPTEMBER, 1926. Vol. XXVIII.

Notes and Comments.

The Industrial Upheaval at Home.

The country congratulated itself in May when the general strike was called off after only ten days; but it did not foresee that the coal strike which gave rise to it was to run to at least nineteen weeks for lack of agreement between mine-owners and mine-workers. Yet the failure of the general strike served a useful purpose, for it made the body of general workers disinclined to do any more sympathetic striking, so the anticipation of the miners that the other trade unions would clinch the matter by refusing to move any foreign coal was doomed to disappointment; and foreign coal has come in by millions of tons and thus enabled the country to carry on—albeit with some difficulty. There seems no doubt now that as a result of their negotiations with the miners during the general strike the other trade unions came to the conclusion that the miners were in the wrong in refusing to negotiate with the owners on the lines of the Coal Commission's Report. This was the deciding factor in terminating the sympathetic strike on their behalf. The miners however were very badly led, and their leaders having committed themselves to a foolish slogan about refusing to work a minute longer or accept a penny less pay in any circumstances, the strike went on for months, with the result that not only have the mining community been reduced to straits, but most of the other bodies of workers in the country, dependent on coal for their daily bread, have suffered more or less severely. That they have not all been thrown out of work has been due to the decision of the transport workers not to refuse to handle foreign coal. So coal—of course at a much higher price—has come into the country fairly freely and has enabled all the necessary services to be carried on; but the ability of industrial firms to continue work has varied with circumstances and location. Those near the ports have had the advantage over the firms more inland.

At the time of writing there seems at length much more hope of a settlement. The miners' leaders have found that in some of the mining areas the men could not be prevented from trickling back to work on new local terms, and the drift back is increasing daily: so the slogan has had to be abandoned and negotiations to be restarted to find some basis that will result in a saving in cost of production—by wage reduction and/or longer working time. All this might have been achieved last May, in fact better terms might conceivably have been secured then than are possible now. The owners are out for district agreements as to wages and hours, and the longer the strike lasts the more they are likely to get their way; the men on the other hand want a national agreement, which means roughly that the richer districts must come to the aid of the poorer ones. It is sincerely to be hoped that a *modus vivendi* may be found soon, such as will give the mining industry, and indeed industry in general, a five years' peace at least. Any forced settlement simply means storing up trouble for a future outbreak. And industry in general in this country, especially the engineering industry, is tired of the interruptions and upheavals which have been so prevalent of late years, and have done so much to retard the post-war restoration to prosperity of our premier industries.

The Sugar Market.

The prospects of a stronger sugar market in the near future have not been lessened by any recent statistics. Reports from some of the principal sugar areas all point the way to probable reductions. Cuba's next crop, it is suggested, may be anything between 4,200,000 tons and 4,500,000 tons as compared with the crop just ended of 4,884,658 tons. The Java crop now being harvested has suffered from dry weather and the latest estimate is that it may be no more than 1,936,000 tons, as compared with 2,278,900 tons last season. The 1926-27 European beet production, as estimated by a Vienna statistician (Dr. MIKUSCH), although it reveals an increased acreage sown to beets (2.169,000 hectares as against 2,119,000 hectares last year), is expected to produce some 319,000 tons less than last year. Czecho-Slovakia, Sweden and Belgium are the principal defaulters, accounting in all for a reduction of 572,000 tons; on the other hand Italy is expected to have 126,000 tons more and the United Kingdom and Russia promise increases of 93,000 and 67,000 tons respectively. Finally, it may be noted that the Mauritius 1926-27 crop is expected to be some 40,000 tons less. All these indications suggest a possibility that the next crop season may for the first time for many years show a *decrease* in comparison with the previous crop. We would express the hope that it may prove so, for the present position of the world's sugar market is satisfactory for no one but the consumer, and he assuredly has no moral right to expect his sugar at a price which is uneconomic for both producer and dealer.

The Beet Sugar Industry in the United Kingdom.

Steady progress is being made with the beet sugar industry in the United Kingdom, though there has been this year a noticeable halt in the number of projects for further factories. The two principal corporations concerned in the industry are evidently disposed to establish their existing factories before they sink capital in yet further projects; while in some districts where factories have been mooted lack of sufficient support on the part of the surrounding farmers has shelved the plans for the time being; an instance is that of the Yeovil factory, first planned in 1925 by the Anglo-Dutch group, which hangs fire till the West of England agricultural community show more willingness to produce a beet crop. There is indeed enough financial support for more than one factory in the western counties, but the farmers are the deciding factor.

According to official statements made in Parliament just before the House of Commons rose for the Recess in mid-August, fourteen factories in all are to be ready for the 1926-27 season, of which one was erected in 1925 (Spalding) but did not work owing to lack of a water supply, and four are new factories erected this year. These last comprise the factories at Peterborough, Felstead in Essex, Poppleton near York, and Cupar in Fife. All the five, except Peterborough, belong to the Anglo-Scottish group. We may add that the other nine which worked last season comprise Cantley, Kelham, Colwick, Ely, Ipswich, Kidderminster, Bury St. Edmunds, Wissington, and Earlestown. In the spring there were indications of at least six new factories being erected in 1926, but the actual number is only four, as above mentioned. The other two, according to the statement in Parliament, are contemplated for erection at a later date.

The area under beet in the United Kingdom this season is estimated at about 128,500 acres, which compares with 56,200 acres in 1925, and about 22,400 acres in 1924. The 1926-27 sugar production is provisionally estimated at between 130,000 and 140,000 tons.

This season the first Irish beet sugar factory, at Carlow, which has been started by a combine of Irish and Continental interests, expects to commence operations. In Ulster attempts are being made to get sufficient support from the farmers for a first factory in northern Ireland.

British Beet Sugar Mission to Germany.

A commission of British beet sugar experts, consisting of representatives of the Board of Agriculture, the Universities of Oxford and Cambridge, the Farmers' Union and of some of our leading factories, paid a visit in July to Rossleben in Saxony, where they investigated the conditions of growing sugar beet seed as practised on the 700-acre experimental farm belonging to Messrs. HÖRNUNG BROTHERS. The Rossleben sugar factory was also visited and inspected. Messrs. HÖRNUNG'S various estates in Germany are reported to extend to 12,500 acres, out of which some 2000 acres each year are devoted to raising sugar beet seed. In a normal year over 2000 tons of beet seed are grown for home use and for export to the principal beet areas of Europe. Another visitor to the European beet fields from the British industry has been Mr. ALFRED WOOD, secretary of the British Sugar Beet Society, who has just completed a tour of Germany, Czecho-Slovakia, Austria, Holland, France and Belgium, where he conferred with the beet sugar authorities on matters of general interest. These two tours besides augmenting the practical knowledge of sugar beet possessed by our own industry have doubtless led to a more general realization abroad that henceforward Great Britain must definitely be included amongst the producing countries of Europe.

Empire Sugar and Customs Drawbacks.

The West India Committee *Circular* draws attention to one of the anomalies in the working of Imperial Preference in this country as regards sugar, which certainly seems to call for redress. The principal sugar refiners here recently reduced the price of their refined product made from Empire sugar by twenty shillings a ton. This measure is understood to be a temporary expedient to relieve the refiners of large stocks of Empire sugar with which they state that they are over-supplied. As is well-known, sugar is refined in this country in bond, the duty being paid on the finished product when it leaves the refinery. When the refiners buy Empire sugar they pay for it a premium actually, or nearly, equivalent to the value of the tariff preference. It follows, therefore, that this premium has to be financed until the sugar has passed through the refinery into consumption; and where purchases have been heavy the amount of money locked up is not inconsiderable. Unfortunately, sugar users having an export trade are disinclined to purchase Empire sugar, since they complain that when they do they are only able to get drawbacks at the preferential rate on their sugared goods exported, though they have had to pay a premium for their raw material. This boycott of Empire sugar by export manufacturers has, undoubtedly, contributed to the congestion of which the refiners now complain. It may be assumed, therefore, that it is to the interest of the sugar refiners no less than to that of the sugar producers to secure the removal of the "taint" which attaches to Empire sugar in the eyes of export manufacturers. This could easily be done, as our contemporary points out, by the adoption of the proposals already submitted to the Government by the West India Committee and endorsed by the planters of Mauritius and Natal through the British Empire Producers' Organisation. They are briefly that sugar users should be allowed drawbacks at the full duty rate provided that they can show that their total purchases of sugar over a given period include sufficient full duty sugar to cover the amount used in the sugared goods exported by them. The adoption of this simple course would, it is thought, serve the double purpose of removing the "taint" from Empire sugar, the existence of which is contrary to the whole sentiment of Imperial Preference, and in relieving the congestion of which the refiners now complain.

International Society of Sugar Cane Technologists.

Our readers will be interested to note that arrangements have now been concluded to hold the next convention of this Society in Havana. Meetings will open on March 14th, 1927, and will continue for about a week, following which an excursion will be made to other parts of Cuba either in small groups or by the Convention in a body, as may be decided.

The meetings that were held in Honolulu in 1924 were of great interest and of great value to all who attended. But the Havana meetings with the larger attendance that is expected promise to be a most exceptional convention for those interested in the technical problems of sugar cultivation and of sugar manufacture. Thirteen sugar-producing countries were represented at Honolulu, namely: Australia, Fiji, Formosa, Japan, Philippine Islands, India, Java, Chile, Mexico, Porto Rico, Cuba, Continental United States, and the Hawaiian Islands. In all probability however, there will be a much wider representation at the Havana meeting, as the membership of the Society now includes all the important cane sugar sections of the world.

Among the general subjects to be discussed are: insect pests of sugar cane; diseases of the sugar cane plant; sugar cane varieties and related problems of seed selection and seedling propagation; protective quarantine measures; field practices such as cultivation, fertilization, tillage, etc.; and the operation and chemical control of the cane sugar factory. The plan followed successfully at Honolulu of discussing topics under the leadership of a qualified specialist is thought to be such a desirable one as to be again followed. Those intending to be present are requested to indicate this by writing to Mr. H. P. AGEE, Honolulu, T. H.; all inquiries regarding hotel accommodation or similar matters may be addressed to Mr. E. L. ANDERSON, Secretary of the Cuba Sugar Club, Apartado 1973, Havana, Cuba, who has kindly offered to assist in particulars of this kind.

The Chemical Catalog Co., Inc., publishers of the very excellent practical work on "Evaporation" by Webre and Robinson, recently reviewed by us,[1] now state that the price has been raised to $8·50 (instead of $6·00).

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[1] *I.S.J.*, 1926, 377.

Fifty Years Ago.

From the "Sugar Cane," September, 1876.

An article entitled "Improvement in the Extraction of Cane Juice," by Robert Graham, of Ponce, P.R., in this number of our predecessor, described the results obtained on the "Restaurada" Estate with a "powerful set of cane crushing and other machinery," compared with the style of mill used until fifty years ago in this old-time sugar factory. "A suitable weighing machine is in use on this estate, all the canes being accurately weighed as they pass on to the mill, the juice is tested, and the number of subsiders filled daily duly noted, the boiler power and the concentrating apparatus (common battery and Wetzel pans) being the same in both cases. The old mill has rollers of 22 in. dia. by 48 in. long, and an average speed of 24 ft. per minute, driven by a horizontal engine with cylinder 12 in. diam. by 30 stroke, the piston making 300 ft. per minute with an average pressure in the boiler of 60 lbs. The new mill has rollers of 36 in. diam. by 66 in. long, and an average speed of 9 ft. per minute, driven by a horizontal engine with cylinder 22 in. diam. by 48 stroke, the piston making 200 ft. per minute with an average pressure in the boiler of 60 lbs., steam being cut off after the piston has travelled $\frac{5}{8}$ths of the stroke." Two tables were presented showing figures for the old and the new mills, but unfortunately these hardly appear comparable, owing to rather different canes ground in by the two, and the nett result was that the new system showed an increase on the crop no less than 46·6 per cent. After this the writer goes on to say: "We hear so much about the great loss arising from the use of single three-rollered mills, one half to two-thirds of the sweets in the cane being said to be lost by their use, which in many cases is true; the fault, however, is not in the system, but in the defective construction and feeding of most mills. Even the large triple effect factories of Martinique and Guadeloupe are said to produce only about 10 per cent. of saccharine matter, which is also the case with the two triple effect factories in this colony. This is, however, considered by many to be a good yield. so that 10·13 per cent. of first jet, good grocery sugar per 100 lbs. of cane will appear to many excessive; while the total result, including molasses and rum, amounting to 87 per cent., or fully $\frac{5}{6}$ths of the sugar, crystallizable and uncrystallizable, contained in the cane, will scarcely obtain credence. A visit, however, to the "Restaurada" would satisfy doubters as to the accuracy of the figures given in both cases, and prove that a much larger yield can be obtained from the cane than is generally believed, and that so far nothing has been invented for the extraction of cane juice than can compete with a properly constructed three-rollered mill. Many writers on this subject hold that powerful mills produce inferior goods. This is an error which no practical man would be likely to fall into. It is true that the more powerful mills separate from the canes more débris and other impurities than is the case with the smaller ones; but by the usual means of clarification the larger quantity of impurities is just as easily removed from the juices as the smaller . . . . Moreover, the high yield of the mills I recommend is not to be attributed alone to the greater pressure brought to bear on the canes, but to the larger diameter and the slow speed of the rolls. The breaking up of the megass is much less, the juice has more time to fall away, and the duration of the pressure is much longer with such rolls than with the usual type of small diameter . . . ."

The Tendency of Trustification in the German Sugar Industry.

By L. H. BAUER.

The unsatisfactory results of the German sugar factories during the last business year have given rise to the question why the sugar industry has not started yet on a similar process of concentration like, for instance, the potash, mining, and iron industries have undertaken or have already completed. With the exception of an amalgamation of the sugar industry in South Germany, nothing has been heard yet of any attempts to create an organization for the central management of all the factories working in the German sugar industry. Even the amelioration in the matter of the corporation tax has failed to act as a stimulus, though the problem of revenue of this industry is considered an extremely serious one.

The cost of production has risen considerably in all stages in the manufacture of sugar, from the raw beetroot to the final refining process. The prices for beetroots are from 70 to 75 per cent. higher than before the war. Regarding the cost of the production of raw sugar the following figures may be mentioned:

	1913-14.	1925-1926.
Average consumption of beetroot in one factory	45,620 tons	35,595 tons
Total cost per ton	7·16 marks	17·90 marks
Taxes (not including turnover tax)	0·30 ,,	1·56 ,,
Wages and contributions to sickness and old age insurance	2·40 ,,	6 02 ,,

From this the causes for the increased cost of production of raw sugar can be clearly seen: In the first instance, it is due to the reduced consumption of raw beetroots by the individual factories which are far from working at full capacity compared to pre-war times. In reality this "running empty" is even greater than it appears from the above figures, when it is considered that most factories are now equipped with more modern machinery than was the case before the war. Secondly, the increase in the cost of production falls to the share of taxes, wages, and social burdens.

It is a fact that refined sugar is sold in Germany at the present time at the cost of raw sugar and that until recently the situation has been still worse. Only thanks to the policy of the Association of the German Sugar Industry in forming an export union has it been possible to obtain relatively better prices on the sugar market by the sale of part of the reserves abroad. The difference between the cost of raw sugar and the price of refined sugar is estimated to be about 100 marks per ton, and as the beetroot growing farmers are the largest shareholders in the German sugar industry, it is consequently the farmers themselves who have to bear this loss; owing to this fact the growing of beetroot has greatly diminished in Germany, which in turn explains the insufficient employment of the factories. Furthermore, it is known that the prevailing low prices are not the only reason for the high cost of production in Germany, but are due in a higher degree to conditions on the world market, inasmuch as many countries, which formerly were only consumers, have taken up their own manufacture of sugar.

Though the conditions prevailing in the German sugar industry are evidently driving towards a greater centralization of production with the aim of reducing its cost, it appears that the difficulties are almost impossible to overcome. The revenue of the sugar industry depends on the result of the crop. This uncertainty in connexion with the impossibility of an extended supply of raw material is preventing the formation of a closer working union between the factories, as on account of the high cost of transportation each factory has to look for raw material to the surrounding district only. In the same manner the farmer is depending on the factory of his district for the supply of feeding stuffs.

Only in the last stage of production, in the refining process, are the conditions such that an amalgamation of the industry can take place without any difficulties because the raw sugar is better able to bear the cost of transportation entailed by longer distances.

In order to enable concentration in the sugar industry to have a chance of success, it is proposed to divide the process of manufacture. The suggestion is made to simply extract the juice of the beetroot in a number of factories which in their turn supply their product to another factory where only raw sugar will be produced. By this means the high cost of transportation for the raw material is eliminated, and furthermore an advantage is gained in avoiding the deterioration of the raw beets which would invariably be the case when transported over a long distance. In expert circles consideration has also been given to establishing pipe lines between factories producing the juice and those manufacturing the raw sugar.

All these problems of a more profitable method in the production of sugar have lately been considered very carefully by the German sugar industry, and the view is expressed that the trials which in this respect have already been inaugurated in South Germany will be followed up in other parts of the country.

Modern Steam Generation.

IV.

By JOHN D. TROUP, M.I.Mech.E.

(Continued from page 244.)

MAINTAINING CLEAN HEATING SURFACES.

In the May issue of the *International Sugar Journal* we dealt with the modern aspect of boiler house control in relation to the combustion side. We propose now to consider the question of transmitting the heat of combustion to the water inside the boiler. Power engineers are giving the problems involved in this section of the boiler house their close attention, with the result that there is now on the market a great variety of plant for maintaining the boiler heating surface in a clean state both internally and externally.

The maintenance of clean internal heating surface conditions is primarily a question of feed water treatment, and we indicated the trend of development towards the ideal of a chemically pure feed water in the April issue. We will therefore devote our attention in this article solely to the exterior surfaces, which involves the problem of disposing of the soot and flue dust.

The amount of soot and dust to be dealt with and the method to be employed is dependent upon the class of fuel burnt and the design of the boiler house plant. The effects of such accumulation of solid matter are twofold. In the first place there is the cost of removal, and in the second place there is the gradual falling off in efficiency of the boilers as the accumulation is allowed to remain. The cost of removal is a more important matter than is generally supposed. It has to be remembered that the boiler flues are much too hot to be entered until some considerable time has elapsed after closing down the plant, and even when they have cooled down sufficiently the work of clearing such flues is not by any means a pleasant one, and therefore is not always carried out with the thoroughness which is necessary for efficiency. Then again, when this work is done by hand, it must necessarily be carried out after relatively long periods of working, as it is not always permissible to close down for a thorough flue cleaning. This means that there is a considerable accumulation of both dust and soot, which gradually reduces the effective area of the flues and increases the coating of non-conducting material on the heating surfaces. This results in the efficiency of the boiler gradually falling off, and modern practice has demonstrated quite conclusively that it pays to instal mechanical plant for keeping the heating surfaces clean.

In practice the methods of removing soot and fine dust may be divided into two sections. First, the use of steam jets for removing soot from the heating surface, and blowing soot and dust to a convenient collecting point, and secondly, the pneumatic method for drawing away the soot and dust at certain fixed points in the boiler house. There is also a combination of the two main methods.

The use of the steam jet for keeping the tubes of the water-tube boiler free from soot has now become standard practice, and this system has also been applied to a certain extent to economizers with the object of dispensing with the usual mechanical scraper, but there is not yet sufficient evidence available to form any opinion on the relative value of the two methods as regards their use on economizers. Both the steam jet and pneumatic methods have been successfully applied to the Lancashire type of boiler, and some large water-tube boiler installations have been fitted with a complete system of pneumatic plant for removing all dust from the boiler flues. This is very simply arranged in the case of a new boiler house, but certain modifications are frequently necessary when the system is applied to existing plant.

STEAM JET PRINCIPLE.

Considering now the actual apparatus used, the application of the steam jet principle to Lancashire boilers will be first considered. The arrangement in this case is a very simple one, and consists essentially in placing a series of steam nozzles at different points in the boiler flues in such a manner that each set of nozzles may be operated in a regular sequence so as to give the flue dust a progressive travel right through the flues, following the course of the flue gases to the chimney base. The nozzles are brought into action at regular periods, say once a day, according to the nature of the fuel and the hours of working.

The advantages and convenience of such a simple system are fairly obvious, and the installation can be carried out by the boiler house staff. It is advisable, however, to carry out the work in conjunction with the makers of this type of plant, as they have naturally acquired much useful experience with installations now at work for a number of years. There appears little to get out of order with such an arrangement, but the nozzles in the furnace flue require to be suitably protected, as this set is close to the full furnace heat.

"HURRICANE" DESIGN.

The "Hurricane" Patent mechanical flue cleaning and soot blowing apparatus, consists of blowers which are operated by steam, and fitted in the fire tubes, bottom and side flues of the Lancashire boiler; the steam is supplied to the blowers in correct sequence by a patent manifold distributing valve, and the only operation entailed is the manipulation of the valve. All dust deposit is blown from the fire tubes, bottom and side flues once every shift, and all soot accumulations on the boiler plates are removed at the same time by blowers specially fixed for the purpose.

The blowers are heavily constructed of cast iron in order to resist the searching action of high temperature gases; in the case of the fire tubes it is usual to fit one large high velocity blower about three feet behind the furnace bridge over which is placed a cast iron plate to protect it from the fierce furnace heat. The blowers in the bottom flue consist of pipe-like units fitted with feet on the underside to hold them clear of the flue floor: on one side it carries four "venturi" jets. The top side is fitted with a raised boss so that a small extension pipe may be screwed in for carrying one of the special plate blowers referred to above.

At the front end of the bottom flue a small elbow blower is fixed, which blows steam across the flue at this point, in order to carry the dust in front of two inclined blowers which raise it into the side flues. The blowers in the side flue only carry two jets of ejecting steam. Angle blowers are fitted in corners when and where necessary.

In order to assist the dust to rise easily to the side flues, the brickwork at the front end of the bottom flue should preferably be radiused, which is quite a simple provision. Additional blowers can easily be fixed in the main flue and economizer soot pit if desired, in which case another manifold valve is required.

The dust and soot may be passed direct to the chimney, but an interceptor is recommended. The "Hurricane" patent dust collecting chamber is designed to work in conjunction with the blowers. This constitutes a brick chamber, preferably elevated, and fitted with a hopper bottom, and discharge door; the inside contains a patent water wall for trapping the dust, and this system has proved to be a most efficient arrestor. The dust is precipitated into the bottom of the hopper in the form of sludge, and may be easily discharged direct into carts or waggons without risk of dust flying about during the operation.

The working of the blowers is very simple and can be safely termed "foolproof." The boiler steam pressure is supplied to the patent manifold valve for distribution, a small drain cock is fixed to run off any condensation before blowing. "Hurricane" blowers are also designed for fuel economizers (to supersede or work in conjunction with existing mechanical scraper gearing), and water-tube boilers (both for tube cleaning and removal of dust from horizontal baffles).

SOOT BLOWERS.

For cleaning the tubes of water-tube boilers a system of steam jets has been devised to be operated somewhat in the same manner as the steam jets for cleaning the Lancashire boiler flues, but the arrangement is of a different character. The apparatus used on water-tube boilers has become known by the name of "Soot Blowers," and the name describes its function, namely, to blow the soot from the exterior surface of the boiler tubes. The present day arrangement is of quite recent design and replaces the old hand lance. It is an interesting example of the trend of development in giving closer attention to detail for the purpose of increasing efficiency. The old hand lance was effective up to a point, but it was not a pleasant job to use it really effectively, and it was not a practical proposition to use it with the regularity necessary for maintaining the highest boiler efficiency. The proof of such inefficiency is made clear in the progress made by the modern soot blower. Its adoption has become general for new water-tube boilers, and it is claimed to effect an annual fuel saving of from 4 to 8 per cent.

DIAMOND SOOT BLOWER.

A typical example of the modern design is the Diamond Soot Blower which has been largely used in America. One of the early difficulties was the fact that the pipes carrying the steam nozzles in the boiler passes were subjected to great heat and would not stand up to such duty. This difficulty has now been satisfactorily solved by using calorized pipes inside the boiler setting which are subject to high temperature. This process is claimed to make the pipes practically impervious to the destructive action of the fire. The arrangement of the boiler consists of inserting a number of permanent tubes at right angles to the boiler tubes and in such positions that the steam jets will completely serve the boiler tube area. These tubes are fitted with specially formed "venturi" type nozzles, equally spaced between each pair of boiler tubes. On the outside of the boiler and attached to each blower tube is a special connecting head, so constructed that the blower tubes can be completely revolved by means of a chain which operates from the firing floor. Permanent steam-pipe connexions are made to each blower head and coupled direct to the superheated steam main.

When it is desired to "soot" the boiler, it is only necessary to open the valve controlling each boiler head in turn, and slowly revolve the blowers by means of the chain wheel which rotates the blower tube by means of a pinion and gear wheel. The whole operation occupies less than 1 min. for each blower, and can be carried out at any time, even while the boiler is under full operation.

The superheated steam issuing from the line of nozzles in each blower tube makes a complete sweep of its surrounding area, so that all soot in its vicinity is immediately and effectively dislodged. The principle is extremely simple, and may be applied to any type of water-tube boiler, their installation requiring very little structural alteration.

PNEUMATIC SYSTEM.

The pneumatic system is applied by two main methods. First, by the installation of pneumatic suction nozzles at different points of the boiler plant. Second, by hand nozzles attached to a flexible hose pipe, when it is necessary to enter the flues. In both cases, however, the plant—with the exception of the nozzle arrangement—is the same.

The ordinary vacuum cleaner—a British invention—invented and patented by Mr. H. C. BOOTH, F.C.G.I., M.I.C.E., over 20 years ago, was really the starting point of the present-day pneumatic system of boiler flue cleaning. The development of this fundamental idea is embodied in the present Booth design, and a further essential feature for flue dust removal is to supply the necessary air at the suction nozzles which constitutes the conveying medium for the flue dust. If we imagine flue dust only being sucked into a long pipe, it will be readily realised that such a pipe would soon become choked up. It is for this reason that a predetermined quantity of air is allowed to enter the suction nozzle with the flue dust, and a specially designed nozzle has been evolved for this purpose.

Plants embodying the Booth patents have been installed at a number of power stations. At the Birmingham (England) Corporation Electricity Works two complete ranges of 21, and 31, water-tube boilers respectively have been fitted with this system, including suction nozzles in the chimneys, and at different points in the boiler passes. These latter positions are so arranged that they operate over the complete area where dust and soot are deposited. At other points it is more convenient to allow the dust to settle into conical shaped chambers, the inverted cone shape allowing the dust to fall down to special aerator suction valves for discharge. Some idea of the work performed by these plants may be formed from the fact that each of the Birmingham installations is capable of dealing with 5 or 6 tons of dust per hour.

Fermentation of Bagasse in Relation to the Yield of Industrial Alcohol.

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INTRODUCTION.

The composition of bagasse, the final product of the milling of sugar cane, varies with the original composition of the cane itself and with the particular process to which the cane has been subjected during milling. In actual working practice, the composition of final bagasse may be placed within the following limits:—Insoluble fibre, 60-30; water, 30-60; and soluble solids, 0·8-1·0 per cent. Its utilization has been directed along the following lines:—

(1) As a source of fuel when sent directly to specially designed furnaces.

(2) As a reserve fuel for mill boilers and locomotive engines, being compressed into bales which are stored for subsequent use. During this storage period the bagasse loses part of its water content, the final product containing from 8 to 15 per cent. water.

(3) As material for making briquettes, the bagasse being stored loosely in the open for a period of 12 to 18 months, subjected to the action of aerobic decomposition organisms which attack the cell structure of the fibre. When the decomposition has reached the point where the original resiliency of the fibre is totally lost, the decomposed material is compressed into fuel briquettes. This process is used extensively at Sf. Djatibarang, Java. It is particularly applicable to those countries where the fibre content of the cane is high, and where the use of wood or oil fuel is a serious problem owing to high prices. Under the latter conditions, the utilization of surplus bagasse above that required for the immediate needs of the factory becomes vital.

(4) For the manufacture of a coarse grade paper, the bagasse being washed free from the saccharose material and water-soluble components.

(5) As a potential source of industrial alcohol or material for paper manufacture, the bagasse being subjected to the hydrolysing action of acid or alkali, and the extract utilized for the former and the fibrous material for the latter.

(6) As a source of "Celotex" or insulating board for the interior lining of dwellings.

BAGASSE FOR "CELOTEX."

The manufacture of this material has been developed extensively in the United States during the past four years.[1] This process shows better possibilities for the economic utilization of bagasse than any other previously introduced.

Green bagasse from the mill is compressed into bales of 200 to 250 lbs. weight and these stored for a period of nine months. Green bagasse is unsuited for direct manufacture because of its resiliency, which property has to be reduced in action, recourse being made to incipient decomposition on storage. During the storage period, deterioration of the saccharine material and of the fibre itself is commenced. However, the deterioration has been found to proceed too far. Economically, this loss is serious, and experiments are being conducted by the manufacturers to prevent this loss by the addition of preservatives to the green bagasse before it is sent to storage.

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[1] *I.S.J.*, 1924, 49, 542; 1925, 34, 196, 274. See also Patents Review.

How far the deterioration is carried by the decomposition of the sugars present in bagasse is not definitely known. The suggestion has been made that by removing the sugars from the bagasse before it is sent to storage, the decomposition could be maintained within the limits required by the manufacturing process.

Direct fermentation of the sugars in bagasse not having been tried, it was thought that such a method might lead to a process of controlling subsequent deterioration of the bagasse fibre.

Fermentation of Sugars in Bagasse.

The sucrose content of final bagasse depends on the original sucrose content of the cane and on the methods of milling. The factors of maceration water and the degree to which the saturated bagasse is milled have a large influence on the ultimate composition of the final product. Any process which sets out to utilize the sugars of bagasse as a potential source of alcohol must necessarily take into consideration the possible yields to be obtained per ton of the bagasse.

Moreover, all the sugars present in molasses are not fermentable. **Maquenne**[1] describes glutose as a hexose sugar of unfermentable nature formed from glucose or levulose when these sugars are submitted to the action of alkalis. It is possible that sugars of like nature may be present in green bagasse or may be formed on subsequent storage. Assuming that all sugars in bagasse are readily fermentable to alcohol, the yield of alcohol per ton of bagasse per unit per cent. of sucrose in bagasse will be 1·41 imperial gallons.

In Louisiana the average sucrose content of bagasse (as reported in answers to questionnaires sent out in 1919) is 4·7 per cent. Assuming the percentage of invert sugar to be 10 per cent. of the sucrose content, we find that the total sugar expressed as invert is 5·37 per cent. Based on these figures, 1 ton of bagasse should produce 7·3 galls. of 95 per cent. spirit. If the amount of bagasse produced is 25 per cent. of the weight of cane ground, then each ton of cane will yield 1·8 galls. of alcohol provided that all the sugars present in the bagasse are of a fermentable nature.

Apart from the possibility of direct fermentation of the sugars in bagasse, several investigators have studied the potential yield of alcohol from the constituents of the fibre itself. When subjected to hydrolysis by acids, the cellulose is converted into sugars, the efficiency of hydrolysis being dependent on the strength of acid and on the temperature of reaction.

Sherrard and **Blanco**[2] used acid strengths varying from 1·8 per cent. to 2·5 per cent. and autoclave pressures of 125 lbs. per sq. inch. The larger portion of the sugars formed were non-fermenting pentoses. **Fowler** and **Bannerjee**[3] submitted the bagasse to a milder action with a view to manufacturing alcohol from the sugars formed, the residual material being investigated as a source of paper pulp. The time of hydrolysis was varied from a few minutes to two hours; the digestion pressures varied from 20 to 65 lbs. per sq. inch. Optimum conditions were acid strengths between 0·25 per cent.—0·5 per cent. and a ratio of acid to fibre not exceeding 6 per cent. of the fibre content, while the maximum yield of sugar was 36 per cent. Allowing the loss of sugar by hydrolysis to be 1 per cent., and also deducting the original sugars in the bagasse (in this case 7 per cent.), the recovery of sugars by hydrolysis of the cellulose was 29 per cent. and the yield of alcohol obtained by fermentation was 8·5 per cent. of the weight of bagasse, in which figure no allowance was made for the residual sugars present.

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[1] L. G. M. **Maquenne**: "Les Sucres et leurs principaux Derivés."

[2] *Ind. and Eng. Chem.*, 1921, 13, 61-65; *I.S.J.*, 1921, 294.

[3] *Indian Inst. of Science*, 1921, 4, 241-260; *I.S.J.*, 1922, 661.

By the above method, the amount of alcohol obtainable is not sufficient to cover the cost of the manufacturing process. Direct fermentation of cellulose to alcohol has not yet been accomplished. LANGWELL[1] says:—

> "So far, no organism has been found which will attack lignified cellulose rapidly under aerobic conditions unless the material be first freed from lignin. Fermentation by organisms which operate under aerobic conditions transforms ligno-cellulose into water, CO_2, and humic substances. Little or no alcohol is produced. By direct fermentation, non-lignified cellulosar material can be made to yield products such as alcohol, acetic acid, butryic acid, lactic acid, CH_4, CO_2 and hydrogen. By suitable further treatment, a type of alcoholic liquid fuel even more satisfactory than alcohol may be produced in quantity as high as 80 galls. of spirit per ton of cellulose."

The possible sources of fuel alcohol obtainable from bagasse are:—(1) Hydrolysis of the cellulose to produce alcohol fermentable sugars; (2) Fermentation of the cellulose material to an alcoholic fuel after the removal of lignin; and (3) Direct fermentation of the residual sugar in bagasse.

DIRECT FERMENTATION OF BAGASSE SUGARS.

In order to obtain information upon the direct fermentation of bagasse sugars with a view to subsequent treatment of the exhausted material preventing the fibre deterioration on storage, the work was planned on the following lines:—(*a*) An investigation of the yields of alcohol obtainable by fermenting molasses wort in the presence of the concentrated water extract from bagasse. (*b*) An investigation of the yields of alcohol obtainable by fermenting molasses wort in the presence of the bagasse itself.

The bagasse used in the experiments was obtained from the Celotex Coy., New Orleans, and consisted of dried stored bagasse from a factory using a Searby shredder. Consequently, the material was finer and of lower sucrose content than the usual Louisiana bagasse. Results obtained with this bagasse could be applied to all the bagasse stored by the Celotex Coy. for manufacture into insulating board. Green bagasse was unobtainable as the crop was finished, but an attempt was made to manufacture a synthetic "green bagasse" and to compare the results obtained under both conditions.

As the amount of fermentable material in the bagasse was very small, all materials were subjected to rigid sterilization. All solutions were sterilized by steaming at atmospheric pressure for a minimum period of one hour. The portions containing bagasse or extract were sterilized twice; firstly, when the original materials were being prepared for the seeding inoculation; and secondly, when the seeding inoculation was sufficiently advanced for transfer. The bagasse-molasses mixture was then cooled down and inoculated with the full contents of the seeding flask in such a manner as to minimize the danger of inoculation of the material by wild yeasts from the atmosphere.

Of the factors tending to influence the results of duplicate experiments, the method of preparing uniform seeding solutions was found to be subject to the least control. At first the main solution was prepared independently from that used for seeding. The seed solution was prepared in bulk, sterilized, and then 200 c.c. inoculated with 10 c.c. of a pure yeast culture. After fermenting for 24 hours, a second transfer of this solution was made to 200 c.c. of stock solution and after this had fermented at 35°C. for 12 hours, the contents of the flask were transferred to the sterilized bagasse-molasses mixture which was then allowed to ferment to completion at room temperature.

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[1] *Industrial Chemist*, Feb., 1925, 1, 14-16.

As the seeding solution was of different composition to that used for covering the bagasse, the results were not strictly comparable, so in order to secure better uniformity of duplicate results the procedure of a further set of experiments was modified.

Sufficient volume of the molasses solution for all experiments was made up to 17° Brix. For every litre of this solution, 1 grm. of ammonium sulphate and 1 c.c. of concentrated sulphuric acid were added. The addition of acid was based upon prior experiments made to ascertain the relative efficiency of fermentation with varying acidities. Results obtained by OWEN show that "the optimum acidification of molasses solutions differs with each yeast culture used and that the acidification of the solution decreases the variations in alcoholic yield in duplicate flasks. The proportion of ammonium sulphate used is that prevailing in industrial work.

After the addition of acid and ammonium sulphate, 200 c.c. portions were transferred to flasks as a base for the preparation of seed yeast for the main flask. To the weighed quantities of bagasse, 300 c.c. of wort was added. After sterilization and cooling, 10 c.c. of a pure yeast culture was added to the smaller portion of 200 c.c., and the mixture allowed to ferment for 24 hours at 35°C. The entire contents of the flask were then transferred to the bagasse-molasses mixture and fermentation allowed to proceed to completion at room temperature.

The alcohol produced by the complete fermentation was determined by submitting the entire contents of the flask to distillation. The amount of distillate collected was at least one-half the original volume of the flask. In those experiments in which the volume was fixed at 500 c.c. of solution, 300 c.c. of distillate were collected in order to insure complete recovery of the alcohol produced.

The specific gravity of the distillate was determined at 15·6°C./15·6°C., and the results obtained were referred to tables published by the Board of Customs and Excise, which give the percentage of alcohol by weight in terms of the specific gravity determined in air with brass weights at a temperature of 15·6°C. and referred to water at the same temperature. From the figures obtained, the total yield of alcohol was calculated.

Analysis of the sterilized molasses solution was made by the Herzfeld modification of the Clerget method for determining sucrose; while reducing sugars were determined by the volumetric method using Soxhlet's solution. In order to calculate the theoretical yield of alcohol from these analyses, the following factors were used:—Sucrose (Clerget) × 1·05 = Reducing sugars by inversion of sucrose. Total R.S. = R.S. by volumetric determination + R.S. by inversion of sucrose. alcohol per cent. by weight = Total R.S. × 0·484.

INFLUENCE OF WATER EXTRACT ON THE YIELD OF ALCOHOL FROM MOLASSES.

(*A*) 500 grms. of bagasse were digested for 1 hour with 8 litres of water; which was then pressed out in a hand press, and evaporated to 3·0°Brix. Analysis of molasses wort:—Sucrose 3·60 per cent; reducing sugars 5·13 per cent.; and available alcohol 4·312 per cent.

Description.	[1] Sp. gr., 15·6–65·6° C.	Yield of Alcohol, grms.	Efficiency per cent.
Extract from bagasse, 1000 grms. molasses wort, 200 c.c. inoculating wort	0·9841	48·427	92·6
1500 grms. molasses wort, 200 c.c. inoculating wort	0·9781	68·415	92·6

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[1] Determined on 500 c.c. of distillate.

(*B*) 1000 grms. were digested for 2 hours with 10 litres of water; 6,400 c.c. of extract were obtained by expression in a hand press, and this extract concentrated by evaporation. Two solutions of molasses wort[1] were made up by dissolving 100 grms. of molasses and completing the volume to 500 c.c., one solution being added to the bagasse extract; and the other fermented as a check. Results obtained were as follows:—

	Alcohol grms.	Efficiency per cent.
100 grms. of molasses in 500 c c. of solution	20·25	75·3
100 grms. of molasses conc. bagasse extract	19·3	74·2

Although the efficiencies obtained in the two experiments are not comparable, the results when examined independently, show that the addition of bagasse extract had no effect on the fermentation in case (*A*) but had a distinct lowering effect in (*B*).

EFFECT OF ADDITION OF DRIED STORED AND SUGAR-EXHAUSTED BAGASSE.

These experiments were made in order to determine whether the effect of bagasse on fermentation was partly mechanical. The exhausted bagasse was obtained by drying bagasse which had been previously fermented in the presence of molasses solution.

No inoculation of the flasks was made from a stock solution; the amount of stock solution added was varied as follows: 10 c.c. of seeding solution for every 50 grms. of molasses used; consequently, a deduction of 0·477 grms. per 10 c.c. of seedling solution had to be subtracted from the actual yield of alcohol in all cases.

	Bagasse			Water Distilled c.c.				
Expt.	Stored. in Grms.	Exhausted in Grms.	Molasses Grms.	Water	Distilled	Sp. gr.[2]	Alcohol Grms.	Efficiency Per cent.
1	—	—	50	500	300	0.99330	10.603	79.20
2	100	—	50	500	300	0.99585	6.330	47.20
3	—	100	50	500	300	0.99320	10.785	80.30
4	—	—	100	500	300	0.98725	21.606	83.10
5	100	—	100	500	300	0.99003	16.146	62.00
6	—	100	100	500	300	0.98755	20.029	77.10
7	—	—	150	500	300	0.98220	31.877	79.50
8	100	—	150	500	300	0.98360	29.696	74.00
9	—	100	150	500	300	0.98225	31.778	78.90
10	—	—	50	1000	500	0.99612	10.032	74.00
11	100	—	50	1000	500	0.99615	10.032	74·80
12	—	100	50	1000	500	0.99600	10.330	77.10
13	—	—	100	1000	500	0.99280	19.001	73.00
14	100	—	100	1000	500	0.99230	20.480	80.40
15	—	100	100	1000	1000	—	—	—
16	—	—	150	1000	500	0.98840	32.222	80.40
17	100	—	150	1000	500	0.98860	31.538	78.40
18	—	100	150	1000	500	0.98860	31.538	78.40

These results show that the addition of dried stored bagasse has decreased the efficiency in all cases except No. 14. In those experiments where exhausted bagasse was used, Nos. 3 and 12 show an increased efficiency.

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[1] Analysis of the molasses used was: Brix 84·6; sucrose (Clerget) 34·2; reducing sugars, 19·6; available alcohol, per cent. 26·867.

[2] At 15.6/15.6 °C., as before.

Effect of Varying Quantities of Dry Bagasse.

Weighed quantities of bagasse were added to 300 c.c. of molasses wort and the mixture seeded for fermentation with 200 c.c. of the same solution used for covering the bagasse, the yield of alcohol being determined on 300 c.c. of distillate. Analysis of wort used was Brix, 17·29; sucrose (Clerget), 5·81; reducing sugars, 5·75; available alcohol, 6·265 per cent.

Expt.	Bagasse Grms.	Sp. Gr.	Alcohol Grms.	Efficiency Per cent.
1a	0	0.98719	22.588	72.11
1b	0	0.98730	22 392	71.48
2a	10	0.98733	22.330	71.28
2b	10	0.98721	22.550	71.98
3a	20	0.98730	22.392	71.48
3b	20	0.98735	22.289	71.15
4a	30	0.98755	21.879	69.84
4b	30	0.98788	21.231	67.78
5a	40	0.98798	21.026	67.12
5b	40	0.98752	21.942	70.01
6a	50	0.98806	20.863	66.58
6b	50	0.98794	21.108	67.38
7a	60	0.98836	20.255	64.66
7b	60	0.98830	20.255	65.11
8a	70	0.99078	15.678	50.02*
8b	70	0.98857	19.844	63.35

Where the proportion of bagasse to molasses solution was high, the decreased efficiency might have been due to evaporation of alcohol from the surface of the bagasse, especially as the flasks were stoppered with cotton wool. Consequently, determinations were made using Alwood's valves on the fermentation flasks. In all other respects the conditions were the same as above. The alcohol available from 500 c.c. of wort was 26·33 grms.

Expt.	Bagasse. Grms.	Sp. Gr.	Alcohol Grms.	Efficiency Per cent.	Remarks.
1	0	0.98635	24.308	92.32	No Valve
1a	0	0.98646	24.083	91.47	Valve
2	10	0.98646	24.083	91.47	No Valve
2a	10	0.98648	24.042	91.30	Valve
3	20	0.98654	23.920	90.84	No Valve
3a	20	0.98650	24.000	91.15	Valve
4	30	0.98654	23.920	90.84	No Valve
4a	30	0.98622	24.457	92.95	Valve
5	40	0.98662	23.753	90.21	No Valve
5a	40	0.98662	23.753	90.21	Valve
6	50	0 98670	23.491	89.21	No Valve
6a	50	0.98650	24.000	91.15	Valve

Effect of an Artificial "Fresh Bagasse."

The dried stored bagasse was twice digested with water and the extract pressed out after digestion, the extracted bagasse being then digested with a solution of molasses and sugar of 12° Brix. and 75 per cent. apparent purity. This mixture was allowed to stand overnight in order to insure complete diffusion, and an "artificial fresh bagasse" was obtained by pressing in a hand-press. Using this bagasse, another set of experiments was made; standard procedure, as outlined previously, was used on this bagasse-molasses mixture, and Alwood's fermentation valves were used on all flasks.

Analysis of the bagasse was: Sucrose (direct polarization), 9·27 per cent.; water, 77·5 per cent.; available alcohol, 4·7 per cent.; and that of the molasses wort: Brix., 18·17 per cent.; available alcohol, 5·21.

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* Low yield was caused by a leaky stopper in distillation apparatus.

		Alcohol	Theoretical Yield			Efficiency Per cent.	
	Sp. gr.	Grms.	Molasses.	Bagasse.	Total.	Molasses	Total.
Molasses Wort	0.98614	24.738	26.043	—	26.043	94.99	94.90
„ „	0.98626	24.493	26.043	—	26.043	94.05	94.05
M.W., 30 grms. Bagasse	0.98577	25.504	26.043	1.413	27.456	97.93	92.70
„ „ „	0.98544	25.995	26.043	1.413	27.456	99.82	94.68
M.W., 50 grms. Bagasse	0.98571	25.647	26.043	2.355	28.398	98.48	90.30
„ „ „	0.98550	26.076	26.043	2.355	28.398	100.13	92.00
M.W. 70 grms. Bagasse	0.98506	27.004	26.043	3.300	29.343	103.69	92.10
„ „ „	0.98546	26.158	26.043	3.300	29.343	100.44	89.13
M.W., 100 grms. Bagasse	0.98470	27.768	26.043	4.711	30.754	106.62	90.40
„ „ „	0.98470	27.768	26.043	4.711	30.754	106.62	90.40

DISCUSSION ON THE EXPERIMENTS.

The experiments with the concentrated water extract from the bagasse show the lowering effect on the percentage efficiency of fermentation. This decrease is shown throughout all sets of experiments and may be due to an inhibiting effect of the gums, non-fermentable sugars and other substances present either in the extract or carried into solution by the molasses wort. In the experiments with dried stored bagasse, the condition of the experiments varies.

Considering all three sets of experiments, it will be seen that the percentage decrease in efficiency varies from nil to 10 per cent. the decrease being, in some instances, affected by experimental conditions. In all cases the decrease is a function of the amount of dry bagasse added. That this decrease is due, partly, to bagasse fibre itself is shown by the experiments in which the molasses solution was fermented in the presence of bagasse which had been added to a fermenting solution and could be assumed to be freed from all fermentable sugars. The decrease in efficiency in all these experiments does not make any allowance for a possible yield of alcohol obtainable from the bagasse sugars. Based on total sugars present in molasses wort and in bagasse, the efficiency figure would be still further reduced.

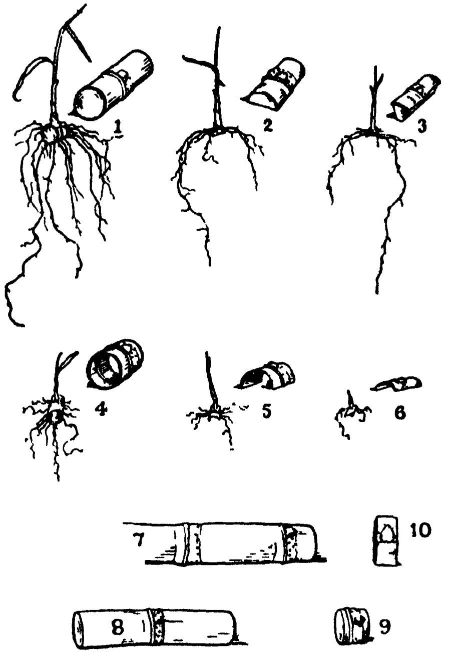
In the experiments with the artificial "fresh bagasse," the duplicate results do not agree very closely. This variation is probably due to the fact that the bagasse obtained by hand pressing was not of the same sucrose content throughout. The difficulty is hard to eliminate and the average result of duplicate experiments should be considered in order to correct the error introduced by varying sucrose content of the bagasse.

When this is done, it will be seen that the efficiency of fermentation of the molasses is increased from 94·52 to 106·62 per cent. by the addition of 100 grms. of artificial bagasse. This calculation is based upon the available alcohol in the molasses wort itself and shows the increased efficiency due to the addition of a definite amount of fresh fermentable sugar in the bagasse. When the calculation is based on the total quantity of alcohol in the molasses and in the bagasse, the results show that the addition of bagasse decreases the overall efficiency of the mixture.

This substantiates the statement that the bagasse itself and not the sugar in the bagasse is the cause of a decreased efficiency of molasses wort fermentation. The amount of alcohol available from the added fresh bagasse increases with increasing weights of bagasse, but the overall efficiency is decreased in amount proportional to the quantity added.

The Sprouting of Sets in the Sugar Cane.

This paper gives the results of a series of experiments conducted at intervals during the past three years, which were designed to emphasize the importance, and define the values, as regards germination of the bud and the growth of the young shoot thus formed, of those parts of the parent stem which are always attached to the bud in the sugar cane, when planting out pieces as sets. At first sight, this might appear to be the work of supererogation. "Germination," in this case, merely signifies the expansion of the organs lying ready prepared but hidden in the sleeping bud, and "growth" implies the formation of new organs. As the bud is completely devoid of any form of stored food or water, and is also incapable of forming rootlets until a considerable development of the shoot emerging has occurred, it is obvious that no such germination or growth can take place without external assistance. The detached bud is, indeed, analogous to the embryo of a seed, carefully dissected away from any stored food which is placed near it, and with its radicular end put out of action. But many cases can be cited where various parts of plants besides the seed can give rise to new individuals. Thus the writer has raised plants from pieces of cotyledons of *Eperua falcata*, and bits of leaves of Begonia, Peperomia, Gloxinia, as well as of certain ferns; and, imitating nature, from a whole series of buds of aerial and water plants, and bits of roots of many others. But in all these cases early formation of roots is essential, often from a prepared swelling called a callus: the bud of the sugar cane, as already mentioned, is quite unable to form these roots. It is quite natural, therefore, that the author in his experiments failed completely to raise cane plants from carefully detached sugar cane buds; and the exceptions in the results are significant as "proving the rule," in that, in every one of them, careful examination showed that one or two root eyes, which are usually few in number near the bud, had been accidentally included.



But, none the less, the author describes an interesting piece of work, from which various lessons may be learnt. The paper is divided into sections, the first of which deals generally with the "rôle of the internode of the cane stem in germination of the bud and the early growth of the young plant from it." Of some half dozen or more experiments he selects two for presentation; but, before referring to these, it will be well to study his figures here reproduced, which indicate very clearly the various amounts of pith and root zone which are left for the use of the buds. No. 7 is a set as normally planted, in which the mature cane stem is cut so as to have three nodes and two internodes: here we have three buds and two internodes between them. The remaining figures show clearly how much of the pith and root zone have been taken away. Two experiments are devoted to the first section.

Experiment I. In January, 1923, buds of Saretha and B 3412 were planted, both as ordinary sets (Fig. 7), and with the central bud alone with small portions of internode on either side (Fig. 9). Sixty buds were planted in each case, and the experiment was made in triplicate. Six months after planting, the "crops" were weighed. In B 3412 the weights obtained under the two modes of treatment were found to be 169 and 52 lbs. respectively, and in Saretha 234 and 170. It may be assumed that only the central bud of the set was allowed to grow, but this is not stated: otherwise the result is not perhaps very convincing.

Experiment II. In March, 1924, B 3412 and Co 213 were tested, 20 buds of each being treated in quadruplicate. The method of treating the sets before planting is shown in Figs. 8 and 9, i.e., with a large and very small quantity of pith left available. The weight of "crop" at four months was, in B 3412 in the first case 42 lbs. and in the second 19; while in Co 213 the figures were 80 and 62.

Experiment III. This was based on a study of the sets planted in the varietal plots of the station; and consisted in a comparison of the germination of the central buds and the end ones in ordinary sets (Fig. 7). The central buds would obviously have more pith to draw upon than the end ones. Four groups of Indian canes were included in the experiment, Mungo with 11 varieties, Saretha with 7, Sunnabile with 5 and Pansahi with 6; to these another, composite, group of 44 Coimbatore seedlings was added. The percentages of germination were as follows:—

	Central buds. Per cent.	End buds. Per cent.	Buds.
Mungo group	64	28	out of a total 660
Saretha ,,	78	50	,, ,, 420
Sunnabile ,,	68	32	,, ,, 300
Pansahi ,,	63	44	,, ,, 1760

The conclusion drawn from this experiment is that the internodes have a distinct value in the germination and growth of the cane plant.

Experiment IV. In all of the above cases the root zones were left intact. In the present one the root zone is included as well, and with or without a complement of pith, by means of slicing and cutting the sets in various ways, as shown in Figures 1, 2, 3, and 4, 5, 6. The cane experimented with was Co 210. The number of germinations are recorded from the 5th to the 13th day; and the (average) relative amount of growth after 17 days is shown in the Figures (1 to 6) drawn from photographs taken at that time. The numbers of germinations of the 13th day were, in the same order, 9, 7, 7, 5, 3, 2; but these figures are only comparative, because the number of sets planted is not stated. No remarks are appended by the author to the results of this experiment, but it is apparently referred to in the summary at the end of the paper as follows: "the deprivation of root eyes and pith has a distinct effect on germination and early growth"—which is perfectly justified.

Experiment V. A further experiment was made with a dozen varieties, grown in two series of pots, in duplicate: in one series the pots being filled with washed river sand and, in the other, with ordinary potting earth. It was found in this experiment that the plants in the sand pots only showed signs of starvation after 6 to 8 weeks from planting. The remark in the summary is that "the ordinary three-budded cane set contains enough food to keep the plant going for at least six weeks." By this time, presumably, the young sugar cane plant would be capable of providing itself with its own set of roots; but we would have liked to have had details as to the varieties used, for it is obvious, from the results of the first two experiments, that the thick cane there used is more dependent on its internodes than the Indian kind.

Experiment VI has already been referred to, namely the attempt to grow isolated cane buds, without any assistance from parts of the parent plant. Fig. 10 is referred to as showing that "as long as a root eye or two and the portion of rind bearing them were included, germination could be obtained, but the resulting plants were weakly."

C. A. B.

Nature and Distribution of the Non-Sugars affecting the Quality of White Beet Granulated Sugars.[1]

By H. S. PAINE and R. T. BALCH.
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Sugar boilers usually hold that within certain limits a better grade of sugar can be produced from a clear, darker-coloured pan syrup than from a turbid, lighter-coloured syrup. This relation, if correct, might possibly be explained on the assumption that the very small suspended particles which cause turbidity become occluded in the sugar crystals by acting as nuclei for crystallization and thus to a certain extent exerting more influence on the grade of the sugar than the typical pigments in the syrup which are present in more highly dispersed condition.

There is involved in this matter the question of the extent to which incorporation of these impurities in the sugar crystals is capable of being controlled; also whether the impurities are uniformly distributed through the sugar crystals. What proportion of the impurities is organic and inorganic? What influence have the clarity and colour of the pan liquors? Does the *pH* of the pan syrups have any influence on the adsorption of colloids and colloidal or non-colloidal pigments by successive surfaces of the crystals as they grow? How do the impurities on the surface of the sugar crystals differ from those distributed in the interior of the crystals? And to what extent can impurities be eliminated by centrifugal washing?

More precise information than has been available is required before these questions can be adequately answered and advance in practice made. The investigation here described was conducted during the 1924 beet sugar campaign for the purpose of obtaining more exact information regarding the points discussed, but is not yet complete.

METHODS AND PROCEDURE.

Preliminary experiments were made with one sample of raw and two samples of granulated sugar in order to acquire familiarity with the procedure adopted. It was apparent that the relative location of the contaminating substances present in the sugar crystals could be determined best by the removal and examination of successive portions of the crystals, this being accomplished by solution in successive portions of water. First the sugar was passed through sieves and the portion between 20 and 30 mesh was retained. Crystals (20–30 mesh) in 500 grm. lots were mixed with 120 c.c. of distilled water in a cylinder and were agitated by rotating and inverting the cylinder until a homogeneous "massecuite" was obtained (this required 3 to 5 mins.); the syrup was then spun from the sugar in a small laboratory centrifuge.

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[1] Condensed from *Facts about Sugar*, 1926, 21, No. 24, 566–569.

The syrup was subjected to various tests and the sugar was air-dried, analysed, and again treated with water by the same procedure, the second wash syrup and final sugar being likewise analysed. The proportion of sugar dissolved from the crystals at a single washing was approximately 50 per cent., which necessitated the handling of a large quantity of sugar in order to finish with a sufficient amount for the desired tests. The portions of the same sample of sugar remaining after each treatment with water are designated as *a* and *b* (column 1, Table I). The crystals *a* and *b* were approximately half and quarter the size of the original crystals, although, of course, all crystals of the same lot did not dissolve at the same rate.

GRADING OF SAMPLES.

The various sugar samples were graded[1] by comparing the colour with that of standard samples under a "daylight" lamp (column 2). The hydrogen ion concentration (column 3) of the various sugar samples was determined as *pH* by the Hatfield[2] colorimetric method, using a 50 per cent. solution; the massecuites were diluted to a 50 per cent. apparent sucrose basis. Column 4 refers principally to the colour of the massecuites after diluting to a 50 per cent. sucrose basis and removing the suspended material retained by an asbestos pad (columns 5, 6, 7). Lovibond's colour standards No. 52, the tints of which match fairly well those of the sugar solutions, were the reference standards. Comparison of colour was made by means of a Kober colorimeter in which the standard colour-plates replaced the usual standard solution.

In spite of the frequent filtration to which the liquors are subjected in the standard process of beet sugar manufacture, there frequently occurs a separation of colloidal material in finely divided form whenever the juice density is materially changed. A massecuite produced from sparkling liquors, when redissolved, will be far from sparkling. The purification accomplished in refineries by simply "melting" raw sugar, mixing the melt with a filter-aid and filtering, is due to a great extent to the irreversibility of colloids which flocculated in the original massecuite. It was desired to ascertain the quantity of such material in the sugar itself as well as in the massecuite, in order to determine the relation, if any, between the two from the standpoint of turbidity. The presence of this kind of material in the sugar affects quality, in that it tends to cause a turbid syrup, especially at higher densities, when the sugar is dissolved. It may also affect the colour and lustre of the sugar crystals.

In order to reduce any effect which dilution might have by way of diminishing the protective action[3] of sucrose on colloidal stability (thus possibly causing further colloidal flocculation), the solutions were prepared at the approximate maximum density for satisfactory filtration (which was accomplished through asbestos in Gooch crucibles). The insoluble residue from the solution of a weighed quantity of sugar was washed free from sugar, dried, and weighed. Samples of sugar commensurate with the quantity of suspended material present were taken; they varied from 50 to 200 grms. of the 50 per cent. solution. The data obtained, recorded in columns 5, 6, and 7, approximately represent material originally present in visible, finely suspended condition in the liquors in the vacuum pan at the time the sugar crystals were growing, including also, of course, any colloidal material which may have flocculated later at the surface of the sugar crystals or when the sugar was dissolved. This material, removed by filtration through an asbestos pad, is primarily responsible for the turbidity of syrup made from the sugar.

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[1] An improved colour analyser suitable for grading sugar has been devised by Prof. A. H. PFUND, Dept. of Physics, John Hopkins University.

[2] *J. Am. Chem. Soc.*, 1923, 45, 940.

[3] ANDERSON, *Trans. Faraday Soc.*, 1924, 19, 635. "Peptizing Effect of Sucrose."

SEPARATION OF COLLOIDS.

Ultrafiltration was selected as the most suitable procedure for separating colloids for quantitative determination, standardized collodion membranes being used as ultrafilters and the residue from 1000–1500 grms. of sample washed and dried at 100–105°C., this giving the total colloids present. Difficulty was encountered when an attempt was made to separate the reversible or "water-soluble" fraction of the total colloidal material thus separated from the irreversible or "water-insoluble" portion. When moistened the dried material formed an emulsion which tenaciously resisted separation by filtration through paper. In transferring the material to the platinum dish from the casserole in which the initial evaporation took place, it was also practically impossible to remove a portion of the residue with water. This residue was found to be soluble in toluene or ether. The total colloidal material was therefore treated with water and extracted with ether. The ether extract was allowed to evaporate spontaneously from a platinum dish, and the residue was dried at 105°C. and weighed. This residue is reported in Table II (column 15) as "ether-soluble."

The separation of the "water-reversible" and water-irreversible" fractions was then easily accomplished through a small ashless filter paper. A number of colloid values are given in columns 8 to 17, inclusive (except column 15). The ether-soluble material represented in column 15 was probably present in emulsified condition in the crystals, but was not really colloidal. Percentages of "water-reversible" colloids can be ascertained by subtracting corresponding values in column 11 from those in column 8, respectively.

DISCUSSION.

By referring to columns 1 and 3, Table I, it will be noted in the case of sugars, 3, 3a, 3b, and 4, 4a, 4b, that the *pH* of the sugar decreases with each water treatment. This indicates that the composition or concentration of the substances in the sugar crystals which are primarily responsible for the *pH* value is different from that of the mother-liquor in the massecuite, and also varies in a rather systematic way in different strata of the sugar crystals. This progressive change in *pH* is apparently to be correlated with a progressive decrease in percentage of ash.

It is seen that the different samples of sugar varied in colloid content, even though the pan liquors had the same general composition with respect to proportions of thick-juice, high wash, and high green. Furthermore, the colloids were distributed rather evenly throughout the sugar crystals (column 8). This fact may be interpreted to indicate a continuous adsorption of impurities of this type upon the surface of the growing crystals. It does not appear that the *pH* value has sufficient influence on the dispersion or properties of the colloids to reduce contamination of the crystals. It is certain that no manner of washing the sugar will free it from the colloidal impurities.

It is a general rule that substances are adsorbed at a solid-liquid interface to a greater extent the more they diminish the surface tension against air, in aqueous solution. The water-reversible fraction of colloids (columns 11 to 14, inclusive) is essentially of emulsoid type and includes gums and similar compounds. One of the characteristic properties of colloids of this type is an increase in concentration at the surface and reduction of the surface tension of aqueous solutions, measured customarily at the liquid-air interface. It would be anticipated, therefore, that the concentration of such colloids would increase, thereby producing adsorption, at a solid-liquid interface such as the boundary of a sugar crystal and the surrounding syrup. As new boundary surfaces are being produced continually during the growth of the crystals, it would be expected that when sugar is crystallizing from liquors which contain emulsoid colloids the crystals would be contaminated throughout their entire volume with such colloids. The data given in Table I are in harmony with this idea, in that the different fractions dissolved from the same lot of sugar contained practically the same percentage of water-reversible colloid.

Table I.

NATURE AND DISTRIBUTION OF NON-SUGAR SUBSTANCES IN CRYSTALS OF GRANULATED SUGAR.

				Material retained by Asbestos and primarily responsible for turbidity.		
Material. (1)	Grade (commercial grading) (2)	*pH* (colorimetric of 50 per cent. solution). (3)	Colour 25 cm. of 50 per cent. solution (No. 52 Lovibond standard). (4)	Per cent. (based on sugar in the sample). (5)	Per cent. (based on original sample of sugar). (6)	Per cent. (based on material retained by asbestos in original sugar sample). (7)
Raw sugar—1	—	—	—	—	—	100
1st wash syrup	—	7.4	14	0 016	0 008	42
Raw sugar	—	—	—	—	—	—
2nd wash syrup	—	7.0	4	0.018	0.005	50
Raw sugar—1b	—	6.9	2	0.003	0.001	8
Massecuite—1	—	6.6	34	0.015	—	—
Sugar—1	B—	6.7	—	0.002	—	—
Massecuite—2	—	8.4	49	0.018	—	—
Sugar—2	C	7.2	—	0.004	—	—
Massecuite—;	—	8 4	52	0.0230	—	—
Sugar—3	C	7.8	—	0.0048	0.0048	100
1st wash syrup	—	—	—	0.0040	0.0020	42*
Sugar—3a	A—	7.6	—	0.0064	0.0032	—
2nd wash syrup	—	—	—	0.0034	0.0008	17*
Sugar—3b	A—	7.4	—	0.0107	0.0029	60*
Massecuite—4	—	7.9	35	0.0093	—	—
Sugar—4	A—	7.1	—	—	—	100
1st wash syrup	—	—	—	0.0018	0.0009	47
Sugar—4a	A	7 0	—	0.0019	0.0010	—
2nd wash syrup	—	—	—	0.0020	0.0005	26.5
Sugar—4b	A	6.6	—	0.0018	0.0005	26 5
Massecuite—5	—	8.2	45	0.0130	—	—
Sugar—5	B	7.1	—	0.0014	—	—

All samples of commercial cane and beet sugars which we have examined contain water-reversible (also water-irreversible) colloids; even those of highest grade contained an appreciable quantity. The influence of colour and lustre of the sugar crystals is determined, not only by the quantity of colloid, but also by such factors as its colour, physical condition, and distribution in the crystal. The foregoing suggests the advisability, in purifying sucrose in the laboratory, of removing colloids from the initial syrup, instead of depending on recrystallization to eliminate colloid contamination. It is also indicated in industrial practice that whenever sugar is crystallized from liquors which contain colloids (particularly reversible colloids) the crystals will be contaminated by such colloids.

The percentage of material retained by asbestos is in general relatively small compared with that retained by the collodion membrane. The ratio of the "water-reversible" colloids to total colloids (column 13) is worthy of note. The percentages of colloids so finely divided as to be retained by a collodion membrane, but not by an asbestos pad, can be ascertained by subtracting the corresponding values in columns 5 and 6 from those in column 8, respectively. The variation in the quantity of colloidal impurities in successive strata of the sugar crystals is not pronounced and may be within the limits of experimental error in some cases, but it appears on the whole that a considerable percentage of the material of the type retained by asbestos is present in the crystals long before they attain their maximum size. This is indicated in the case of sugar 3b (after two treatments with distilled water), the turbidity (column 5, suspended material retained by asbestos) of which in 50 per cent. solution was considerably greater than that of the other fractions. This indicates that particles of flocculated colloids or other suspended material in the pan liquors acted as nuclei on which crystallization started and were thus occluded in the crystals. It is also noted in column 5 that the quantity of this material in the sugar increases in general with that in the massecuite.

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* Total of these values determined independently is 119 per cent.

Table II.—COLLOIDS [1]
(material retained by a colloidal membrane).

Material.	Total per cent. (based on sugar in the sample). (8)	Water-reversible. Per cent. (based on sugar in the sample). (11)	Water-reversible. Per cent. (based on total colloids in sample). (13)	Water-reversible. Ash per cent. (based on sugar in the sample). (14)	Ether-soluble per cent. (based on sugar in the sample). (15)	Ash of the water-irreversible fraction per cent. (based on sugar in sample). (17)
Raw sugar—1	—	—	—	—	—	—
1st wash syrup	0.059	—	—	—	—	—
Raw sugar—1a	—	—	—	—	—	—
2nd wash syrup	0.051	—	—	—	—	—
Raw sugar—1b	0 048	—	—	—	—	—
Massecuite—1	—	—	—	—	—	—
Sugar—1	0.0175	0.0115	—	0.0019	0.0008	—
Massecuite—2	—	—	—	—	—	—
Sugar—2	0 0170	0.0100	—	0 0016	0 0006	—
Massecuite—3	— *	—	—	—	—	—
Sugar—3	0.0198	—	—	—	—	—
1st wash syrup	0.0193	0 0127	66	0 0011	0 0007	0.0034
Sugar—3a	0.0196*	—	—	—	—	—
2nd wash syrup	0.0182	0.0118	65	0.0012	0.0004	0.0023
Sugar—3b	0 0206	0.0106	52	0.0011	0.0004	0.0066
Massecuite—4	—	—	—	—	—	—
Sugar—4	0.0099	0.0069	69	0.0007	0.0007	0.0014
1st wash syrup	0.0093	0.0056	69	0.0007	0.0012	0.0013
Sugar—4a	0.0116*	—	—	—	—	—
2nd wash syrup	0.0112	0.0058	54	0 0007	0.0005	0.0025
Sugar—4b	0.0120	0.0069	57	0.0007	0.0007	0.0024
Massecuite—5	—	—	—	—	—	—
Sugar—5	0.010 (Approx.)	—	—	—	—	—

Ash content.—The ash contents of the two fractions of colloids were rather high, and the difference in their composition is probably similar to that found by PAINE, BADOLLET, and KEANE of this laboratory.[2] The ash of the water-irreversible portion was gray in colour and that of the water-reversible fraction was dark brown. The manner of occurrence of these inorganic substances in the colloids of the sugar is difficult to determine. There are three principal possibilities: (1) They are present in colloidal condition as separate inorganic compounds; (2) they are present in the organic colloids in chemical combination;

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* Calculated.

[1] Columns 9, 10, 12, and 16 giving values as percentage of original sugar here omitted.

[2] Unpublished investigation.

(3) they are adsorbed by the organic colloids. If this inorganic material had been present in free molecularly dispersed condition it would have passed through the ultrafilter.

The water-reversible colloid from one sugar sample was examined for optical activity and was found to have the specific rotation $[\alpha]^{20}_{D} = -30 \cdot 6^{\circ}$. This is approximately the specific rotation of a gum prepared by dialysis from beet molasses by PAINE and WALTON.[1] The water solution of this material did not reduce Fehling's solution until after hydrolysis by hydrochloric acid, indicating that it belongs to the group of highly polymerized carbohydrates termed gums.

An inspection of the table shows that practically all of the inorganic material in the sugar (ash, columns 14 and 17) exists in water or sugar solution as crystalloids (molecularly dispersed condition) and hence passes through the ultrafilter. The greatest contamination of the sugar by impurities of this type occurs in the more external strata of the crystals. Although the salts may be adsorbed on successive surfaces of the sugar crystals during growth in the presence of an ever-increasing proportion of non-sugar substances in the syrup films surrounding the crystals, it is probable that a large proportion exists merely as a final crystal-surface contaminant due to the failure to remove completely the films of mother-syrup in centrifugal washing.

CAUSES OF INCOMPLETE WASHING.

This relatively incomplete washing is due in part, at least, to the sugar crystal formations. Watching the growth of crystals in the pan liquors by the aid of a microscope showed that multiple crystals or cluster formations were very prevalent. Although the crystals were single at the beginning of crystallization, this condition continued only until sufficient grain had been formed and the supersaturation was lowered, crystallization being then continued upon the crystals already present. It is not known whether the impact of the crystals against one another during the course of boiling is sufficient to cause the formation of nodule crystals upon their surfaces, or whether two or more crystals adhere to one another long enough to permit an intimate crystallization of sucrose upon their surfaces, resulting in the formation of one crystal imbedded in another. Close inspection of any finished sugar will reveal many scars upon the surfaces of the crystals where they were once united. Under such conditions it appears that occlusion of films of mother-syrup is very likely to occur between the adjacent surfaces of the crystals. Centrifugal washing in the factory fails to remove such impurities, as the clusters are not extensively broken down into single crystals until the sugar passes through the granulators. Hence the impurities present in these films are retained by the sugar crystals, chiefly as a surface contaminant. If it were possible to control the crystallization of sugar in the vacuum pan in such a way as to reduce greatly the tendency toward cluster formation, it would be possible to purge the resulting sugar better and possibly eliminate much of the surface contamination with a minimum quantity of water.

That a great proportion of the material responsible for colour and for lack of lustre of the sugar crystals is present in the more external strata is evident from the fact that in the case of sugar No. 3 (columns 1 and 2, Table 1) the grade was raised from C to A—by the first treatment with water. This treatment also removed 64 per cent. of the total ash of the sugar. Discoloration of sugar crystals may occur through adsorption of some of the colouring material (either colloidal or non-colloidal) present in pan liquors as well as by exclusion of liquor between crystals.

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[1] *Ind. Eng. Chem.*, 1924, 16, 1252.

South African Report on Electrification of Sugar Factories.[1]

Statistics on the application of electricity in the sugar industry prove that the problems have been overcome satisfactorily and that now complete "electrification" is no experiment, but rather an accepted standard for modern mills of large capacity.

In Natal electrification has been carried out only on a moderate scale and for only a portion of auxiliary plant; but it is certain that in no one instance has the installation been made without considerable benefits accruing, which will have their effect when larger new plants and extensive alterations to older plants have to be considered.

CHOICE OF SYSTEM.

In view of the experience already gained within the industry and the standard adopted by the large municipalities and mining groups, the standard system should be 3-phase, 50 cycles, 6600, 2200, and 550 volts.

The fact that the S. A. Railways and Harbours have adopted a standard of 440 volts for low tension equipment is to be regretted, as it is not likely that their demand will ever be comparable with that of the large mining and industrial groups, which are too far committed to alter their existing standards. Local experience goes to show the advisability of A.C. in every instance.

STANDARD OF EQUIPMENT.

At present practically no control is exercised in regard to the type of equipment permissible to employ.

While no accidents due to electric shock have been recorded in the mills attributable to faulty electrical apparatus, it is to be recommended that in view of climatic conditions, the proportion of unskilled labour employed, and the unavoidable accumulation of moist dust in the mills, apparatus as far as possible complying with the British Home Office requirements only should be used.

TYPES OF STEAM ELECTRIC GENERATORS.

The choice of prime movers rests between the steam turbine and high speed steam engine. Gas and oil engines have no field excepting for week-end and off-season load on account of the low thermal efficiency as compared with back pressure steam plant in process work.

Where superheated steam at high pressure is obtainable, and units of 500 k.w. and higher are being considered, the steam turbine will in most cases prove most favourable as regards: first cost; floor space; oil consumption; and maintenance.

But with low steam pressures, not superheated, and in all cases for units below 500 k.w. the high speed engine proves most favourable as regards: first cost; steam consumption; simplicity; and reliability.

For steam pressures of 120 lbs. and above, the compound engine should be considered on account of its lower steam consumption.

At present no sugar mill in Natal has adopted steam turbine drive; whereas in Cuba alone steam turbines are installed to the total of 193,000 k.w. as compared with reciprocating engines for electrical purposes to the total of 11,700 k.w. The steam turbine is predominant in Cuba for two reasons: the size of units is generally large, and American influence is great. In America the engineering market conditions are such that high-speed engines have not been developed to the state of perfection demanded in England.

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[1] Report (here condensed somewhat) on Electrification by Sub-Committee of the South African Sugar Technologists' Association, Proceedings of the Fourth Annual Congress, 5-10.

South African Report on Electrification of Sugar Factories.

EXTENT OF ELECTRIFICATION.

In the case of existing factories the question of total electrification involves very great capital expenditure, which for moderate size mills would be difficult to justify. But the electrification of auxiliaries reduces steam consumption and maintenance costs, improves reliability, cleanliness, and flexibility of plant.

The principal Natal mills have already had sufficient experience to prove that auxiliary electrification meets all the claims made, and none would care to revert to the older methods after having had experience of an electrified plant.

It has been suggested that on a steam efficiency basis electrified mills cannot compete with the latest type steam mill. Whether this is correct or not, depends entirely on each particular case. If in a newly laid out plant the boilers, steam pressure and superheat are fixed to suit an electrified mill, then it can generally be accepted that the electric will show an overall heat economy much higher than attainable with the steam drive.

The main claims for electrification do not lie in the direction of steam economy, but rather in : the centralization of power plant ; resultant cleanliness of factory ; ease and flexibility of control ; absence of steam pipes and drains ; and great reduction in maintenance costs.

In the past the main objection to 3-phase plant for this purpose was the instability of induction motors working under variable speed conditions, with the resulting controversy between direct and alternating current equipment. This undoubtedly held up the progress of electrification considerably, but in recent years the problems of electric mill drive have been more thoroughly understood by the electrical machinery manufacturers, and the old apparent, sometimes real difficulties have been completely overcome by the adoption of new methods.

This phase of the subject could only be dealt with adequately in a paper by itself. We therefore only intend to show the trend towards progress in electrification in other parts of the world.

Country	Electrical Generator Capacity k.w.	Number of Complete Electrified Mills
Natal	5,750	Nil
Australia	3,000	Nil
Java	3,000	1 (under construction)
West Indies	25,000	No data available
Cuba	195,000	15 (5 of which are under construction.)

It would be of value to know the relative power required for milling one ton of cane in Natal compared with Cuba for equal sized mills, also to know the economic power rating of, say, a 34 in. × 78 in. mill crushing alternately Cuban cane and Uba cane. It may be that equal mills will have a larger rating on Cuban cane than on Uba cane for the same power. These are factors that should be investigated.

One point of argument which is still undecided, even in Cuba, is the relative speed variation between mills. This facility is not obtainable with group drive steam-driven tandems, and it would be interesting to have mill engineers' views on the subject.

It is assumed that the variable speed facility is to compensate for worn rollers, to avoid choking, and it is a point again for the mechanical engineers to investigate whether the advantages gained justify the additional apparatus rendered necessary.

In a completely electrified factory the boiler equipment should be designed to meet the requirements of the turbine plant, and every effort should be made to prevent large pressure fluctuations in either live or exhaust steam ranges.

The installation of special boilers for the turbine plant or the alternative of the separation of the boilers from the boiling house by means of automatic control valves, should always be resorted to for satisfactory service. The avoidance of priming and of fluctuating steam pressures is of paramount importance in a completely electrified mill.

MOTOR APPLICATIONS.

Mill rolls.—The problem as affecting this most important part of the plant lies in the gearing and method of coupling.

To date apparently only individual mill drives have been installed, with motors of relatively high speed coupled by means of flexible couplings to helical oil-bath reduction gears for the first reduction, the remaining reduction being effected by means of open type, machine cut, steel gears of standard mill design.

The results from mills having been in service for from 4 to 8 years show that this equipment is very reliable.

Should the speed variation between individual mills be considered of no advantage, then the question of group drive with larger motors might be given consideration. It would not give quite the flexibility of individual drives but would be cheaper, and would still show the main advantages over steam engines.

Centrifugals.—Group driving by belt is still generally favoured, but individual motor drives are becoming more popular and in Cuba large new installations on these lines are being made for next crop.

In the past trouble has been experienced due to the exceptionally heavy starting torque and bad power factor conditions as a consequence; but motors have now been designed suitable for this purpose with special control apparatus of a simple but effective nature, enabling adjustable acceleration to suit different grades of sugar. These have all the robust characteristics of ordinary squirrel cage motors, but have slower acceleration and exceedingly high average power factor over the cycle.

The elimination of belts and greater certainty of producing a uniform product should commend this type of application which will no doubt become more popular when it is better understood.

Air pumps and compressors.—Owing to the inherent reliability of slow running slide valve type, dry air pumps, not much progress has been made in electrifying these old steam units. The time will come, however, when they will also have to give way to electric drive, and no difficulties should be presented in this application.

With centralization of the condenser system using one large air pump, the units can be of substantial size and suitable for direct coupling to synchronous motors, thereby improving the system power factor which in some cases is very desirable. This type of drive is very common in other industries of similar nature and is gaining ground in Cuba.

Pumps.—One of the greatest advantages of electric power in a mill is the utility of direct connected centrifugal pumps. High efficiency centrifugal pumps applied to pumping juice and syrup are not altogether satisfactory; the best results are to be expected from pumps having large running clearances and of rugged construction. The reduction in efficiency is of small importance compared with the additional reliability and reduced cost of maintenance.

Losses in a centrifugal pump are represented by a conversion of work into heat which is absorbed by the liquid being pumped, resulting in increase of temperature. Obviously in the case of boiler feeding and most cases of juice pumping this increased temperature is beneficial. There are no difficulties in application, the rugged squirrel cage motors being used in almost all cases up to 75 h.p. for direct coupling.

It is desirable to have the units coupled by means of flexible couplings to permit both motor rotor and pump rotor to take up their correct relative positions, and also to provide a sufficient surplus in power rating to take care of reduction in pump efficiency due to wear. When motors are to be started by means of direct starting switches, care should be taken to see that the pumps are fitted with discharge valves to reduce the torque. This system of starting is not recommended for units larger than 10 h.p.

Conveyors and elevators, etc.—The remaining applications are mainly of a nature similar to general factory conditions in all industries. For moderate speed reductions, belt drive still proves most economical and cheaper in first cost, and the flexibility of this drive minimizes wear and tear of motors.

Direct coupled gear reductions of the pinion and spur type are not recommended, particularly the self-contained back geared motor, principally due to the vibration set up within the machine, which in due course is likely to affect the windings. There are many efficient types of planetary and worm reduction gears and if used in connexion with flexible couplings render high ratio reductions simple and compact.

Floor space should be as clear as possible to permit washing by means of a hose pipe. When the building structure is strong enough motors mounted overhead on brackets or girders, or underslung from girders avoid taking up valuable floor space, and are kept out of harm's way from the hose pipe and dirt.

BENEFITS FROM ELECTRIFICATION.

Concentration of power plant in the power station, where the steam is economically used, is a great advantage over the multiplicity of small engines and pumps with their live steam and exhaust pipes and drains.

The facility of being able to add a power-driven unit here, and a labour-saving device there, is a most valuable combination offered by electricity.

It is impossible to define the limits of usefulness of electric power in the sugar industry: in the laboratory, in the workshop, also in the fields for irrigation pumping, and in the near future for ploughing, and in the yards for hauling and hoisting.

STATE OF ELECTRIFICATION OF NATAL MILLS, 1926.

Number of mills operating	25
Capacity in tons cane per hour	800
Number of generating sets installed	45
Capacity of generators in kilowatts	5,755
Number of motors installed	256
Horse-power of motors installed	5,277
Number of mills using electric power	13
Number of mills using electric lighting only	13
Mills using direct current for power	7
Mills using alternating current for power	6
Capacity of D.C. generating sets K.W.	2,410
Capacity of A.C. generating sets K.W.	3,343
Mills using high-pressure steam for generating sets	6
Mills using superheat for ditto	2
Available K.W. from hourly cane crushed (approximate)	40,000
Percentage of electrical plant installed to total possible	14.5

Study of the Absorption Spectra of Factory and Refinery Products.[1]

By T. B. WAYNE,
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PART 1.

PETERS and PHELPS,[2] of the National Bureau of Standards, by a study of absorption spectra and luminosity integrals of many sugar products, have formulated a simple method wherein the intensity of absorption at 560 mμ may be converted into a correct colorimetric determination. In control work, if standard colour solutions are prepared and standardized in terms of absorption at 460 mμ, and then viewed in comparison with the unknown sample through a light filter transmitting light of an effective wave length of 560 mμ, a satisfactory and simple colorimetric method results. In this manner the original syrups or liquors are directly compared, and the troublesome difficulties arising from certain colloidal and chemical phenomena attending the dissolving and purifying of the products are avoided.

The most useful feature of this new method of colour determination is the absorption ratios, which PETERS and PHELPS designate as the ratio, Q, between unit absorption at 560 mμ and absorption at other wave lengths at definite intervals throughout the spectrum. A study of decolorization by chars when using this method reveals certain facts concerning the kind of colouring matter adsorbed by char under definite conditions of comparison as regards density, purity, time of contact, reaction, etc.; that is, if solutions are prepared which are nearly identical in all of these particulars and are treated under identical conditions, one can then determine what regions of the spectrum yield most readily to adsorption by the char. The types of colouring matter in the sugar product to be decolorized may be grouped according to their absorption ratios, Q, which PETERS and PHELPS use to indicate the relative absorption at other wave lengths than 560 mμ throughout the visible spectrum.

TESTING THE D.P. OF CARBONS.

The lack of an understanding of the quality of the colouring matter in a sugar product has led to many erroneous comparisons between various activated carbons. Some investigators have selected a dilute solution of blackstrap molasses as a standard solution for testing the decolorizing efficiencies of various carbons; and after treating portions of this solution with equal or varying proportions of the carbons under examination, have attempted to arrive at a figure representing the relative efficiences of the carbons. They have really obtained adsorption curves for these carbons on that particular solution containing its particular types of colouring matter at that one concentration. Other factors which automatically entered into the conditions of these tests were (1) time of contact, (2) concentration of the test liquor, (3) composition of the test liquor, (4) temperature, (5) reaction of both the test liquor and carbon, and (6) other miscellaneous factors such as viscosity, clarity of the test liquor, and the fineness of the carbon. All of these must be duplicated in order to secure identical results, and the same carbons subjected to different conditions may show entirely different efficiencies. The only method of comparison that is approximately correct is one in which all of these factors are similar to those encountered in the industrial conditions under which the carbon must be used. The carbon which attains the results expected of it at the lowest net cost per unit of refined product is selected, and in making this selection there are many factors other than the decolorizing efficiency to be considered.

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[1] Abridged from *Ind. Eng. Chem.*, 1926, 18, 847-848.

[2] *Sugar*, 27, 223 (1925).

Blowski and Bon[1] have made comparisons between various activated chars taking into consideration the factors influencing the decolorizing action on sugar liquors. One of these factors, the effect of the "quality of colour" in the liquor, has been discussed briefly by making adsorption curves for carbons on four test liquors each containing a different type of colouring matter. But no attempt was made to examine these test liquors spectrophotometrically to determine, if possible, just what types of colouring matter were present in these liquors, and how each affects the decolorizing efficiency of the carbon.

The data presented below are the result of an attempt to identify the different types of colouring matter found in raw sugar and in refinery products and, if possible, to account for their origin. Of course, in doing this it will also be possible to locate those parts of the spectrum in which bonechar shows the greatest adsorption.

The Colouring Matter in Cane Juice.

Chlorophyll, anthocyan, saccharetin, and certain polyphenols of iron have been located in varying amounts in the raw juice. Some of these are readily eliminated by clarification with lime and heat, while others are more troublesome and may pass into the clarified juices and syrups from which the raw sugar is boiled. Most of them impart a grayish colour to the products in which they appear, and raw sugar boiled from improperly clarified juices is usually characterized by a grayish or greenish colour. This colour is largely in the molasses film on the crystals and is separated into the affination syrups when the sugar enters the refinery wash plant, but may also occur in the crystals themselves. In the latter case the sugars cannot be washed white, and the washed sugar liquors therefrom have a greenish or grayish cast which is easily identified and recorded by means of spectrophotometric analysis.

In presenting these data (Table II) the words "colour" and "colouring matter" have been used freely to designate what the practical observer visualizes. Technical sugar products are usually classified as red, yellow, grayish, or greenish, according to the physical sensation registered by the observer's eye. However, in order to record these sensations and yet avoid the highly technical nomenclature and descriptions used by the physicist in classifying colours, the writer has used the absorption ratios of Peters and Phelps[2] as a means of tracing the absorption trends of the different products at different wave lengths throughout the visible spectrum. Since in this discussion we are not primarily concerned with the quantitative determination of colour, the $-\log t$ values at 560 $m\mu$ and at the other wave lengths selected are not given in all cases, and the reader is expected to follow the *trend* of the absorption ratios given, as these are indicative of the quality of the light-absorbing bodies present. All measurements were made with the Keuffel & Esser colour analyser, and the $-\log t$ values from which the Q ratios were calculated are on the basis of 1 grm. solids per c.c. and 1 cm. cell thickness.

Table II shows a spectrophotometric analysis of a typical gray sugar of Philippine origin.[3] After the washing process and filtration through Sweetland filters using "Filter-Cel," the spectrophotometric analysis of the washed sugar assumes a different colour distribution curve. The trend of the curve made by plotting absorption ratios against wave lengths shows something of the origin of the colouring matter present in sugar products. Raw cane juice would have a curve different from the sugar just mentioned, and different from the improperly clarified juice from which this sugar was boiled, because the red colour developed during the manufacturing process will increase toward the last stages of the process and produce a sugar showing more absorption in the blue end of the spectrum. In order to make a bright raw sugar, the juice clarification must be complete enough to remove most of these grayish or greenish bodies, although the juice acquires more colour of a red or yellow character. That is, upon spectrophotometric analysis the absorption curve will be higher in the blue end of the spectrum, denoting a reddish colour in the product.

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[1] *Ind. Eng. Chem.*, 1926, 18, 32.

[2] *Sugar*, 1925, 27, 223.

[3] Sucrose, 96·28 ; invert, 1·13 ; ash, 0·50 (sulphated, 0·78) and non-sugars, 1·49 per cent.

It is evident that in washed sugars the gray colouring matter may be boiled into the crystals. Whether this colouring matter is due to ferric compounds, or to anthocyan which has not been completely precipitated from juices expressed from dark coloured canes, is problematical.

Regardless of all theoretical considerations concerning the probable composition of the gray colouring matter found associated with certain raw sugars, in refining raw sugars we have to contend with (1) the gray colouring matter which may have been derived from the cane or through the presence of iron polyphenol compounds developed during the manufacturing process, (2) the red colouring matter formed by the action of heat and alkalis on the reducing sugars during process, and (3) any colouring matter which may have developed from miscellaneous sources, which for practical purposes may be disregarded.

RED COLOURING MATTER DEVELOPED DURING PROCESS.

Caramelization.—When sucrose and invert sugar are heated in neutral solutions for any length of time, incipient caramelization occurs with the formation of compounds which impart to the solutions what is commonly designated as a red colour. In the presence of alkali, even in small quantities, the formation of this colour is greatly accelerated. Spectrophotometric analyses of colour formed during the various stages between incipient and nearly complete caramelization—in fact, caramelization far enough advanced to cause the formation of considerable carbon—show a progressive decrease in the absorption ratios in the blue end of the spectrum accompanied by some increase in those for the opposite end of the spectrum.

Two solutions of pure sucrose were prepared and decolorized completely by treating with an iron-free decolorizing carbon. The first of these solutions was adjusted to 57·5° Brix at 17·5°C. and the second to 50° Brix at 17·5°C., and both were then adjusted to exactly *pH* 7·0. The water-white sucrose solution was then coloured with the various caramel solutions in the form of filtered water extracts. The caramel syrups thus prepared were finally adjusted with the two sucrose solutions until they were at a density of 55·0° Brix at 17·5°C., and after being filtered optically void they gave transmission readings of between 18·0 and 20·0 in a 10 cm. tube when read at 560 mμ in the Keuffel & Esser spectrophotometer. It was considered desirable to read all of the caramels so prepared at the same value for c (grms. saccharine solids per c.c.) and so that they all had practically the same $-\log t$ value at 560 mμ. Then, since the same optically void solution was read throughout the spectrum at certain wave lengths selected to yield sufficient data for tracing the absorption trend of each caramel, by using cells of different thicknesses (values for b) $-\log t$ values were established, and from these the absorption ratios, Q, were calculated.

Table II.—SPECTROPHOTOMETRIC ANALYSIS OF PHILIPPINE RAW SUGAR.

	Wave Length, mμ						
	440	460	480	500	520	540	560
—Log t	3.392	2.766	2.185	1.764	1.509	1.306	1.153
Q	2.94	2.40	1.89	1.53	1.31	1.13	1.00

	Wave Length, mμ						
	580	600	620	640	660	680	700
—Log t	1 034	0.902	0.808	0.722	0.634	0.551	0.475
Q	0.90	0.78	0 70	0.63	0.55	0.48	0.41

Table III—SPECTROPHOTOMETRIC ANALYSIS OF SUCROSE CARAMELS EXPRESSED AS ABSORPTION RATIOS, Q.

	Wave Length, mμ							
Caramel	440	450	460	480	500	520	540	560
(*a*)	—	9.15	7.51	4 77	3.21	2.19	1.50	1.00
(*b*)	7.60	6.65	5.91	4 00	2.83	2.03	1.42	1.00
(*c*)	4.41	3.96	3.50	2.60	2.00	1.61	1.27	1.00
(*d*)	3.74	3.38	3.07	2.47	2.00	1.61	1.27	1.00

	Wave Length, mμ						
Caramel	580	600	620	640	660	680	700
(*a*)	0.70	0.49	0.33	0.25	0.18	0.12	0 09
(*b*)	0.71	0.52	0.38	0.28	0.21	0.17	0.13
(*c*)	0.80	0.63	0.52	0.42	0.34	0.28	0.22
(*d*)	0.79	0.64	0.50	0.39	0.30	0.27	0.22

Table IV—EFFECT OF LIME ON CARAMELIZATION OF SUCROSE SOLUTIONS, EXPRESSED AS ABSORPTION RATIOS.

	Wave Length, mμ							
Caramel	440	450	460	480	500	520	540	560
(*a*)	—	9.42	7.86	4.85	3.16	2.15	1.46	1 00
(*b*)	6.16	5.46	4.80	3.45	2.47	1.85	1.32	1.00
(*c*)	4.37	3.93	3.48	2.61	2.00	1.62	1.28	1.00
(*d*)	3.70	3.31	2.99	2.30	1.89	1.50	1.24	1.00

	Wave Length, mμ						
Caramel	580	600	620	640	660	680	700
(*a*)	0.70	0.51	0.36	0.27	0.20	0.14	0.11
(*b*)	0.77	0.59	0.46	0.33	0.26	0.21	0.18
(*c*)	0.81	0.64	0.52	0.43	0.35	0.29	0.24
(*d*)	0.82	0.67	0.55	0.43	0.37	0.31	0.26

Briefly summarized, in order that these caramels might be directly compared with technical sugar products, the absorption ratios, Q, were obtained in exactly the same manner as is recommended by PETERS and PHELPS.[1] The calculation selected in each case is based on light absorption at each wave length selected for 1·0 grm. saccharine dry substance in 1 c.c. and 1 cm. cell thickness. In calculating absorption ratios, Q, absorption at 560 mμ is 1·00, and absorption at the various other wave lengths selected is ratioed accordingly. This procedure allows direct comparisons to be made between the trends of the absorption curves of different products without regard to their respective colorimetric equivalents. Since, in the case of the caramels, the objects are to treat them as though they had been formed in process by the action of heat and alkalis on the sugars and to establish the fact that caramels possessing different trends to their absorption curves are formed under different conditions, no colorimetric equivalents are necessary.

(*a*) Ten grms. of C. P. sucrose were dissolved in 20 c.c. of neutral distilled water. The solution was poured into a porcelain casserole and heated cautiously with constant stirring until a yellow colour began to form. It was then cooled and, after diluting with water-white sucrose syrup, was prepared for spectrophotometric analysis by repeated filtrations through an especially prepared asbestos mat in a Gooch crucible until no turbidity could be detected when viewed before a powerful slanting beam of light. (*b*) A similar solution of sucrose was heated in the same manner except that the caramelization was carried to the point where the solution was distinctly red. It was then diluted with water-white sucrose solution and analysed as described above. (*c*) The experiment was repeated in the same manner, except that caramelization was continued until the entire contents of the dish became black and brittle after cooling. (*d*) In this instance the caramelization was carried to the point where a considerable amount of carbon had formed. The absorption ratios of these solutions are shown in Table III.

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[1] *Loc. cit.*

Effect of Lime and Heat.—Under the usual manufacturing conditions in a raw sugar factory, the red colouring first forms during the heating of the limed raw juice. For best results in clarification, the raw juice is usually limed to about *pH* 8·4, and, after coming out of the heaters and settling, the clarified juice from a good clarification has a reaction of about *pH* 7·6. Under these conditions, and to a lesser extent when the clarification is more acid, the juice acquires a red colour from the action of lime and heat on the invert sugars present. After this clarified juice is concentrated in the multiple effects, the reaction has dropped to *pH* 7·0 or lower, depending on the original reaction of the clarified juice, and whatever colour is acquired after that may be regarded as the result of heat alone, if we disregard the possibility of iron compounds.

In order to study the effect of lime on the quality of colouring matter formed by heat in the presence of free alkali, the experiments described under sections (*a*) to (*d*) were repeated with the variation that in each case the sugar solutions were adjusted to *pH* 8·6 before applying the heat. The results are shown in Table IV.

Although lime greatly accelerates the rate of colour formation, it is doubtful whether the quality of the colour thus formed will be any different from that formed by heat alone, if the latter could be determined at the same degree of caramelization. In each instance, whether the caramelization is accomplished by the action of lime and heat or by heat alone, the first incipient action produces a colouring matter with a very high absorption ratio in the blue end of the spectrum, and as the action proceeds the absorption curve tends to straighten out by a decrease in the blue end and some increase in the red end of the absorption spectrum.

EFFECT OF FERRIC IRON.

Ferric iron, as a producer of a grayish cast in certain sugars and sugar products, has been studied by SCHNELLER,[1] ZERBAN,[2] and GEERLIGS[3]. Polyphenols and related compounds, which are present originally in the raw juice or formed later in process, react with ferric iron to produce ferric polyphenol compounds.

Anyone who has had experience in raw sugar manufacture is familiar with the darkening of juices when allowed to stand. This is more noticeable when there is a temporary pause in the manufacturing process; the mill juice will darken while standing in the juice tanks, and the clarified juice will do likewise, especially if allowed to cool somewhat. As this darkening occurs both before and after the juice has been limed and heated, it is evident that natural polyphenol compounds have been active. There is also a possibility that polyphenols or related compounds have been formed later in process.

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[1] La. Agric Expt. Sta., *Bull.* 157 (1916). [2] *Ibid.*, 165 (1919).

[3] "Cane Sugar and its Manufacture," 1909, p. 8. (NORMAN RODGER, London.) "Practical White Sugar Manufacture," 1915, p. 8. (NORMAN RODGER, London).

To investigate this point further, 33 grms. of 50° Brix invert sugar syrup were treated with a solution of ferric ammonium sulphate in such a manner as to bring the ferric content up to 100 parts per million of Fe. This syrup and a similar portion without the iron treatment were placed on a wide hot plate and boiled down until the caramelization was fairly complete. Both caramels were taken up with water-white sucrose syrup and prepared for spectrophotometric analysis in the usual manner.

The caramel-coloured syrup from the check sample was then treated with ferric iron in the same proportion, and after refiltration was analysed. The results of both treatments are shown in Table V.

Table V.—Effect of Ferric Iron on Absorption by Caramels as Shown by Absorption Ratios.

	-Wave Length, $m\mu$-						
Caramel	440	460	480	500	520	540	560
+ 100 p. p. m Fe....	3.50	2.81	2.26	1.79	1.45	1.15	1.00
Check	3.92	3.07	2.45	2.00	1.59	1.26	1.00
Check + 100 p.p.m. Fe	3.65	2.91	2.33	1.85	1.50	1.24	1.00

	-Wave Length, $m\mu$-						
Caramel	580	600	620	640	660	680	700
+ 100 p. p. m. Fe ..	0.83	0.70	0.59	0.50	0.43	0.37	0.31
Check	0.82	0.67	0.53	0.42	0.33	0.28	0.24
Check + 100 p.p.m. Fe	0.84	0.71	0.60	0.50	0.43	0.37	0.31

These experiments indicate that compounds of ferric iron and polyphenol compounds formed by the destruction of sugar do exist, and will cause the formation of a grayish colour, but that colour from this source is very likely to be of secondary importance to that formed as the result of interaction of natural polyphenols of the cane with iron acquired from the mills, tanks, and other equipment in the sugar factory. The amount of iron used in these experiments is more than will be likely to occur in the primary juices, liquors, and syrups of the sugar factory, and the formation of polyphenols or related compounds by the destruction of sugar has been greater, possibly, because of the more complete caramelization. However, the absorption curves of these iron-treated caramels show that the colouring matter formed in this manner cannot account for the gray or greenish colour of certain raw sugars, as the latter often exhibit much less absorption in the blue end of the spectrum, and with a higher absorption in the red end, than do the caramels presented above. The physical equivalent of such absorption curves is—a grayish sugar.

A study of the absorption ratios of typical raw sugars of colours ranging from bright red to a dull gray will reveal that the colouring matter is composed, first, of the grayish or greenish bodies derived mainly from the raw juice because of failure to eliminate them by proper clarification, and second, bodies produced by the action of heat and alkalis on the sugars, both with and without the presence of ferric iron. The quality of the colouring matter is determined largely by the proportion present of these two opposite types of coloured bodies.

(*To be continued.*)

The Effect of Moisture on the Loss of Sugar from Sugar Beets in Storage.[1]

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The effect of temperature on the storage of sugar beets has been studied for years, but the effect of moisture on sugar-beet storage has apparently received little attention. The aim of this work was: (1) To obtain more information bearing on the earlier statements of the writer[2] that sugar beets lose less sugar when stored moist than when stored dry; (2) to determine the specific moisture conditions required by sugar beets during storage in order to decrease to a minimum the loss of sugar from them; and (3) to point out the necessity of special and definite moisture control in the storage of living tissues in general.

General Methods.

All the investigations were carried on under constant temperatures. Sugar beets, which were healthy and fairly uniform in sugar content, were selected for the experiments. Storage periods were long, i. e., about 100 days or more in duration and, after storage, all beets which showed signs of decay were discarded before analysis. Values for sugar are given as sucrose. The order of sampling and weighing the beets was the same as reported earlier by the writer,[3] with which method comparable weights and percentages of sugar were obtained for each beet by analysing the same individual beets both before and after storage.

In 1921 the writer found for the first time that sugar beets lost more sugar under dry than under moist storage. Early in 1922 this was confirmed by a further test in which five beets were packed in air-dry sand, at each of the following constant temperatures: 1·7°, 4·4°, 9·4°, and 14 4°C.; and similar lots of beets were packed in moist sand at the same temperatures. In general, the beets stored in dry sand lost more sugar than the corresponding lots stored in moist sand at each of the different temperatures.

On April 8th, 1922, from 2 to 3 kg. of beets were stored dry at each of the above-stated constant temperatures and similar check lots were stored moist at the same temperatures. Again the average loss was higher for the beets stored dry, though exceptions appeared at both the highest and lowest temperatures. These exceptions, however, were undoubtedly due to variations in moisture content of the sand.

In an experiment started on November 23rd, 1923, more constant moisture conditions were obtained by packing some beets in cans with 60 per cent. saturated moist sand, and others in air dry sand. The cans contained from 8 to 10 beets each. A set of the moist and a set of the dry packed beets were placed at the constant temperatures of 1·7°, 4·4°, 9·4°, and 14·4°C. The average results, showing the sugar lost by the moist and by the dry stored beets at each of the constant temperatures, are given in Table I.

The analyses show consistently that the beets stored in moist sand lost less sugar under each of the constant temperatures than those stored dry.

On November 17th, 1922, 64 beets were packed in sand, the moisture content of which was such that its surface tension was in equilibrium with an osmotic pressure of 6·0 atmospheres pressure at 4·4°C., and these beets were designated the "moist lot." At this date 80 similar beets were packed in drier sand, the surface tension of which was in equilibrium with an osmotic pressure of 10·0 atmospheres pressure at 4·4° C., and these beets were designated the "dry lot." After 110 days' storage, it was found that the moist lot had lost 12·9 per cent. of its sugar content, and the dry lot 16·5 per cent. Thus, over a prolonged period, only a slight increase in the moisture content of the packing medium resulted in a saving of 22 per cent. more sugar.

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[1] Condensed fron *Journal of Agricultural Research*, 1926, 32, No. 12, 1143-1152.

[2] *Facts About Sugar*, 1924, 19, 178-180, 208-209, 232-233, 235, 251-253. [3] *Jl. Agr. Research*, 1923, 26, 125-150

TABLE I.

The Effect of Moisture as a Condition of Storage on the Loss of Sugar by Sugar Beets.

Temperature. °C.	Moisture Conditions.	Sugar Content of Beets at beginning of Storage. Grms.	Sugar lost. Grms.	Sugar lost. Per cent.
1·7	Moist	192	22	11·5
1·7	Dry	190	32	16·9
4·4	Moist	174	26	14·9
4·4	Dry	204	51	25·0
9·4	Moist	199	35	17·6
9·4	Dry	208	75	36·1
14·4	Moist	186	30	16·1
14·4	Dry	231	87	37·6

On November 17th, 1923, 5 lots of 50 beets each were placed in storage for 103 days under definite moisture conditions at the constant temperature of 4·4° C. Not only were the beets weighed and analysed individually, both before and after storage, but the surface tension and the per cent. of water in the sand were determined for each moisture condition. Table VIII gives these results reduced to the terms ordinarily used by the beet sugar industries of Europe and America. These data show definitely that the percentage of sugar lost by beets during storage increases as the dryness of the storage condition increases.

TABLE VIII.[1]

Relative amounts of Sugar lost by Beets accompanying the loss or gain in weight of Sugar Beets during 103 days' storage at 4·4°C. and under various moisture conditions.

BEFORE STORAGE.		AFTER STORAGE.					
Weight of Beets. Kg.	Weight of Sugar in Beets. Kg.	Condition of Storage.	Loss or gain in weight of Beets during Storage. Per cent.	Sugar lost during 103 days' Storage. Kg.	Sugar lost per 100 kg. of Beets. Kg.	Sugar lost per 100 kg. of Beets per day. Kg.	Sugar lost per ton of Beets per day. Lbs.
55·135	9·980	Very dry	— 42·7	2·050	3·7181	0·0361	0·722
71·160	12·700	Dry	— 7·4	1·600	2·2484	0·0218	0·436
69·975	12·590	Medium	— 2·9	1·430	2·0436	0·0198	0·396
68·660	12·326	Moist	+ 1·8	1·049	1·5277	0·0148	0·296
50·245	9·135	Very moist	+ 9·5	0·933	1·8569	0·0180	0·360

A graph plotting the relation between the per cent. gain or loss of weight of beets and the per cent. loss of sugar during storage (values being taken from Table VII) indicates that the smallest loss occurs when the beets retain their normal amount of water. The normal water content was maintained by keeping the moisture in the packing material equivalent to, or a little higher than that of normal beet tissues.

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[1] The results are calculated from Tables II, III, IV, V, VI, and VII (for which see original article).

The values for the mean and standard deviation of per cent. loss of sugar, the per cent. loss or gain in weight of the beets in lots 1, 2, 3, 4, and 5, and the differences for lots 1 and 4, are given in Table IX. These data were calculated from the per cent. loss or gain for each beet. The results show, as was earlier reported by the writer,[1] that individual beets are irregular as to the per cent. loss of sugar and the per cent. change in weight during storage. The irregularities are due to individual characteristics of the beets and their condition at the time of storing. Some of the causes of these irregularities in weight were earlier reported by the writer.[2] The differences between the amount of sugar lost and the changes in weight of the beets of lots 1 and 4 are significant and of value to the industry.

TABLE IX.

The Mean and Standard Deviation Values for the per cent. Loss of Sugar.

	PER CENT. LOSS OF SUGAR BY BEETS.		PER CENT. LOSS OR GAIN IN WEIGHT OF BEETS.	
Lot No.	M.	σ	M.	σ
1 ..	20·48 ± 0·87 ..	9 16 ± 0·62 ..	− 42·94 ± 0·87 ..	9·14 ± 0·62
2 ..	12·82 ± 0·75 ..	7·83 ± 0·53 ..	− 7·58 ± 0·34 ..	3·54 ± 0·24
3 ..	11·28 ± 0·62 ..	6·54 ± 0·44 ..	− 2·82 ± 0·35 ..	3·67 ± 0·25
4 ..	8·56 ± 0·35 ..	3·63 ± 0·25 ..	+ 1·83 ± 0·33 ..	3·40 ± 0·23
5 ..	10·58 ± 0·60 ..	6·29 ± 0·42 ..	+ 9·68 ± 0·43 ..	4·54 ± 0 30
Difference, 1–4 ..	11·92 ± 0·94 ..	—— ..	44·77 ± 0 93 ..	——

To determine the limit of the beneficial effect of increased moisture during storage, beets were submerged in water at 4·4° C. for 164 days. These beets lost an average of 55 per cent. of their sugar, though some fermentation had started before the end of this period. The excessive loss of sugar in this case apparently was due to lack of aeration rather than to the increased supply of water. This was substantiated in further tests in which the sugar beets were abundantly supplied with free water, but were well aerated. Here the loss in sugar was appreciably less.

To determine the applicability of these results to commercial practice, several hundred pounds of beets were stored 43 days, during the fall of 1924, in bins corresponding to sections of commercial sugar beet piles. The beets of one bin were stored just as in the ordinary storage pile. Those of a second bin were similarly stored, except that they were kept moist. As reported in an earlier publication,[3] the beets as ordinarily stored lost 75 per cent. more sugar than did the beets which were kept moist.

DISCUSSION.

Sugar losses and chemical changes resulting from the physiological processes of the living and healthy stored roots in the commercial storage of beets have received attention. It should be clearly understood that the storage of rotten, diseased, or dead beets is not under consideration here ; furthermore that the ordinary methods of food preservation by means of heat, chemicals, sugar in high concentrations, drying, or freezing, are not effective, as when beets are killed by chemicals, heat, or freezing the loss of sugar and decomposition processes proceed rapidly, unless careful protection is afforded. To carry these treatments to a point where they would stop all biological and catalytic action on so large an amount of material, even if otherwise practicable, would be too costly. Under such difficulties, therefore, sugar beets must be kept alive in storage.

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[1] *Jl. Agr. Research*, 1923, 26: 125-150. [2] *Facts About Sugar*, 1925, 20: 874-875.

[3] *Through the Leaves*, 1925, 13: 157-159, 206-207, 272-274.

Results of the present investigation show that in order to conserve the maximum amount of sugar, the conditions of storage must be so controlled that the water content of the beet is kept normal. On the other hand, the beet seems to be under optimum conditions for growth and respiration, when it contains its normal amount of water. These processes, of course, tend to consume the reserve sugar of the beet, but the difficulty is overcome by subjecting the beet of normal water content to a low temperature. The writer[1] has found that 1·7° C. would inhibit growth and reduce to a minimum the respiration of normal sugar beets; thus the life processes which use up the reserve sugar are inhibited or slowed up. The writer has kept sugar beets healthy and at a high sugar content for 18 months under these conditions. Even though reserve food is slowly used up by these retarded physiological processes, the loss is near the minimum, and in the development of the dormant habit in nature an economical storage method, at least for living tissues, has been evolved. It is interesting to note that in order to reduce to a minimum the sugar lost by beets during storage, the tissues must not only be kept alive, but they must be kept as dormant as possible.

Brevities.

The "Suchar" carbon refining operations at Mercedita, P.R., are described as an "unqualified success." It is stated that the granulated made has been selling at a premium; that under 1 per cent. of carbon has been used; that 5 strikes were boiled "snow-white"; and that the recovery was 93·6 per cent of the raws melted. Negotiations are said to be proceeding for the formation of two companies, one to control the process in the Western Hemisphere, and the other in British territories.

Pneumatic transport of materials has been considerably improved and extended, and plant simple to install and to operate is now in use for the conveyance of materials as diverse in nature as cork, granite chips, steel turnings, tobacco, small coal, cotton, peas and paper cuttings, it is claimed with entirely successful results. There is only one moving part, the fan, and the material does not pass through it, while also means are provided for delivery to any number of points.

Considerable developments are said to have taken place in the direction of manufacturing artificial fertilizers.[2] "Kaliammon-salpeter" and "Leuna-salpeter BASF," are offered as substitutes for Chilean nitrate, but are cheaper per unit of nitrogen. "Harnstoff BASF," is urea, and contains no less than 40 per cent. of nitrogen. Then mixed fertilizers are "Diammonphos," "Leunaphos" and "Leunaphoska BASF," which, in addition to nitrogen, contain phosphoric acid. and in some cases (as in the last named) also potash.

A process of manufacturing betaine hydrochloride, a nitrogenous base, occurring in beet juice, has been developed by the Mellon Institute of Industrial Research, and the construction of a factory is planned[3] Hitherto sold under the name of "Acidol," this compound is valued in therapeutics by reason of the fact that it liberates hydrochloric acid on hydrolysis, but so far it has been available only at a very high price. It can serve as a substitute for tartaric acid, and is also a potential source of trimethylamine and other methylamines. Details regarding manufacture by this new method are not published.

"Cush-cush" present in the mixed juice is known to cause the solution of noncellulose constituents during liming, a lower purity than would otherwise obtain thus resulting. Juice strainers have been developed in T.H., which are capable of removing about 50 or 60 per cent. of this suspended matter. But this advantage is offset by the disadvantage of a slower filtration of the settlings, due to the absence of the insoluble matter, which acts as filter-aid. W. E. Smith[4] believes that the scheme in operation at the Pioneer Mill, T.H., solves the problem, the material screened from the juice being returned to the settlings, so that no change in their filtering quality results.

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[1] *Facts About Sugar*, 1924, 19, 178-180, 208-209, 232-233, 235, 251-253.

[2] *Times Trade and Engineering Supplement*, June 12th, 1926.

[3] *Ind and Eng Chem.* (*News Edition*), 1924, 4, No 10, 7.

[4] Reports of the Association of Hawaiian Sugar Technologists, October, 1925, pp. 122-123.

Mannite, a useful pharmaceutical product, at present obtained in Sicily from plants of the genius *Fraxinus*, can now be prepared by fermenting sucrose with a special organism found in asparagus juice, yields up to 20 per cent. being thus obtained.[1]

A total production of 8,115,231 piculs (479,204 tons) of centrifugals, and 220,000 piculs (12,991 tons) of brown sugars is reported as the output for Formosa for 1925-26. In the previous season the figures were 7,992,348 piculs (472,000 tons) of centrifugals.[2]

Acreages planted to beet in the U.S.A. during the present year total 754,797, Colorado leading with 221,668, Michigan second with 120,446 and Nebraska third with 80,762 acres.[3]

A. J. V. Underwood[4] has now constructed a nomograph for calculating the pressure and stress in centrifugal machines, given the load, the pressure on the basket, the speed, and the rim stress and the diameter of the basket.

A novel process[5] of refining sulphur has been invented by W. H. Bentley, the crude material being dissolved in the molten liquor from a previous operation to form a polysulphide which is then treated with hydrogen sulphide under certain conditions of temperature and pressure so that elemental sulphur is precipitated.

"Scientific research, properly applied and carried out, is never wasted. It may prove that a thing can be done, or that it can not be done. But even the proof of a negative may save the waste of further effort."—The Prince of Wales in his Presidential Address at the Oxford Meeting of the British Association for the Advancement of Science.

The Prime Minister has nominated the Marquess of Titchfield, M.P., as representative of the Conservative Party on the Executive Committee of the British Sugar Beet Society in succession to Captain F. N. Blundell, M.P., who has resigned in consequence of the pressure of his duties as a Member of the Imperial Economic Committee. The representative of the Labour Party on the Society's Committee is Mr. V. G. Crittall, and Major Goronwy Owen, D.Sc., M.P., represents the Liberal Party.

Finsbury Technical College (of the City and Guilds of London Institute) was finally closed on July 26th, due to lack of funds owing to the increase in the cost of maintaining such an institution following the war. Several famous men such as Ayrton, Perry, Armstrong, Meldola and S. P. Thompson, held professorial appointments at "Finsbury," and many of its students occupy important positions in different branches of technology all over the world. The closing of a training centre with such a distinguished record is greatly deplored.

Sir Daniel Hall, formerly Director of the Rothamsted Experimental Station, in his presidential address to the Agricultural section of the British Association, at Oxford, made a gloomy forecast in regard to world food supplies, and pointed out that intensification of production is the only alternative to famine. Speaking of conditions in this country, he said that "our employment of fertilizers continues to be unnecessarily low even under later conditions of prices." This is unfortunately only too true in the case of superphosphate, the consumption of which has declined to a point below pre-war standards.

The Patent Committee of the American Chemical Society is pointing out that many chemical patents have been granted which are absolutely unworkable and which the simplest kind of experimental demonstration would prove to be unworkable. On the other hand, there have been cases where, in the opinion of the U.S. Patent Office Examiner, the process was unworkable and an application not allowed which really might have been a good one. This points to the conclusion that, especially in chemical patents, the decision regarding many cases might be greatly expedited and more accurate conclusions reached if some method were easily available for the testing out of reactions as might be required by the Patent Office Examiner. This examination could be carried out by a "Patent Court." A great advantage of requiring demonstrations in doubtful cases would be in preventing the issue of patents that do not really describe the process which they are intended to protect, very prevalent in patents granted to German inventors who wished to obtain protection without disclosing the real secret of their inventions.

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[1] *Zymologica*, 1925, 2, 101.

[2] Report of the Department of Overseas Trade, August 12th, 1926.

[3] *Western Irrigation*, August, 1926, p. 16.

[4] *Chemical Trade Journal*, 1926, 79, No. 2047, 192-193.

[5] U.K. Patent, 252,938.

Publications Received.

Sugar Cane Syrup Manufacture. Compiled by H. S. PAINE and C. F. WALTON, Jr., Carbohydrate Laboratory, Bureau of Chemistry, Washington. Department Bulletin, No. 1370. (Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.) 1926. Price: 10 cents.

In this Bulletin the manufacture of table syrup as carried on in the United States is described in a comprehensive way, being largely a compilation of data from various sources, some of which have been printed in bulletins and journals. Much new material, however, including descriptions of model plants and apparatus, supplemented by sketches, and cost data, with a comparison of different methods of manufacture, including the use of invertase, is now included. Clarification by SO_2 and lime is discussed by Dr. C. E. COATES and W. G. Taggart; clarification by lime alone by C. F. WALTON, Jr., ; mechanical clarification, that is, using kieselguhr filtration, by the same gentleman; and treatment with decolorizing carbons again by Mr. WALTON. There is a section on the equipment and cost of making syrup on a large scale by Messrs. L. J. LASSALLE and J. J. MUNSON, tabulating data for plants of increasing capacity; and also a very readable article by Mr. WALTON on the prevention of crystallization by the invertase process, and by Dr. OWEN on the principles and technique of canning as applied to this industry. It is a very valuable bulletin for the use of the American table syrup maker.

(1) **Vragen gesteld op het Schriftelijk Deel van het Syndicaats-Examen, 1920-26.** (H. VAN INGEN, Soerabaja, Java). 1926. (2) **Het Oplossen van scheikundige Vraagstukken.** IR. M. SNEL. (Jhs. Klaasesz & Cie., Hengelo (O), Holland. Price: 2 Florins.

(1) For the use of students preparing for the examinations conducted under the auspices of the Syndicate of Sugar Manufacturers in Java, papers set at examinations since 1920 are here collected, these having reference to Theoretical Chemistry; Sugar Manufacture; Factory Control; and Plant Apparatus; and First Aid. These papers show the high standard of training that is required of the sugar chemists and engineers in Java. (2) This small book is mostly a collection of chemical calculations (with solutions) for the use of the classes held at Nijmegen for students qualifying for the diploma of Analyst of the Chemical Society of Holland. These problems are well chosen, and are of a comprehensive nature dealing with different aspects of gravimetric and volumetric analyses and physical questions.

Lime: Its Uses and how to apply It. (The Anglo-Scottish Beet Sugar Corporation, Ltd., Colwick, Nottingham). 1926.

This well-written 6-page leaflet discusses the rôle of lime in agriculture; its special value for soils on which beet is cultivated; and when and how lime should be applied. It reproduces tabulations of field trials, proving clearly the increased yield of sugar on limed soils as compared with unlimed conditions. "Lime is, of course, a soil stimulant to a certain extent, but it is just as necessary for plant growth as nitrogen, phosphoric acid, or potash, as it is itself one of the ten essential soil constituents without which plants cannot grow. If one applied lime to the soil year after year without growing clover or applying farmyard manure, the soil would eventually become 'run down,' and would take years to regain its former state of fertility. Lime should not be used alone, but in conjunction with farmyard manure, although it is not good practice to apply them both together. . . ."

Review of Current Technical Literature.[1]

OXIDATION OF GLUCOSE (DEXTROSE) DURING THE MANUFACTURE OF CANE SUGAR.

F. Hardy. Tropical Agriculture, 1926, 3, No. 8, 165-167.

Preliminary Prof. HARDY points out that it was early suspected that the acidity of cane juice may increase by boiling it in contact with air, due to oxidation of the glucose (dextrose) constituent of the reducing sugars, with the formation of gluconic acid, simpler poly-hydroxy acids, or perhaps lactic acid. Even limed juice is known to become measurably more acid on evaporation, changes in its *pH* value from say 7·2 to 6·9 having been recorded in the boiling house,[2] and it is possible that oxidation may take place more readily in alkaline than in acid solution. These products of glucose oxidation are significant in cane sugar manufacture, firstly, as they are the precursors or concomitants of certain humic substances conferring an undesirably dark colour, and secondly, as their very unstable calcium compounds are responsible for troublesome frothing in stored molasses, liberating CO_2 among their products of decomposition. Then the author draws attention to recent investigations carried out by American chemists on the mechanism of glucose oxidation. H. A. SPOEHR, J. H. C. SMITH, W. G. YOUNG, and P. C. WILBUR,[3] have shown *inter alia* that a catalyst such as ferro-pyrophosphate, hastens the oxidation of various sugars by atmospheric oxygen; and that the presence of phosphates exerts a stimulating action on the oxidation, the dextrose being converted into levulose, or into some more highly active form of dextrose before it is oxidized. M. H. POWER and F. W. UPSON,[4] examining the oxidation by air of dextrose in calcium hydroxide solution, found that at weak alkalinities, and in the absence of oxidizing agents, this sugar is mainly converted into other mono-saccharide sugars, a result noticed by LOBRY DE BRUYN[5] and by NEF.[6] The American chemists further noticed among other observations that contact of dextrose and lime-water for some months leads to extensive formation of saccharinic acid, carbon dioxide, formic acid, oxalic acid, *d*-arabonic acid, glycolic acid, and various unidentified hydroxy-acids. Following this, Prof. HARDY indicates some of the possible applications of the results of the above results (here briefly summarized). Oxidation products of the glucose (dextrose) component of cane juices may include a great many different and unexpected compounds the nature and relative amounts of which will doubtless vary according to the conditions of manufacture. Certain components of sugar-factory liquors, such as *iron-compounds* (introduced perhaps mainly as impurities through contamination from machinery and plant), and phosphates, may profoundly affect the course and the end-products of glucose oxidation. The time factor is very important in deciding the nature and significance of the oxidation products, the greater the time the more complex and diverse will apparently be the results of oxidation. The formation of dark-coloured products through side reactions accompanying the process of oxidation, may largely be suppressed by the presence at the right time of certain reactive substances (stannous chloride and hydro-sulphites possibly acting largely in this way). Oxidation may be lessened or prevented by treatment of juices with excess of sulphur-dioxide at an early stage in sugar manufacture; this tending to produce a permanent reducing atmosphere in the evaporator vessels. The possibility of the fixation of phosphate as phosphoric esters of sugars at the higher temperatures realized during sugar manufacture (particularly when phosphates are indiscriminately added to sugar liquors), should be recognized as a probable complicating factor in sugar manufacture; and lastly that many disturbing elements may render doubtful the interpretation of the results of chemical analysis of sugar-factory products, and extreme caution should always be practised when employing conventional methods of examination (especially those involving the use of Fehling's solution) in attempts to explain peculiar or exceptional results that may present themselves during actual factory experience.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *Cf.*, *I.S.J.*, 1925, 383.

[3] *Yearbook of the Carnegie Institute of Washington*, 1925, No. 24, 154-160. *J. Amer. Chem. Soc.*, 1924, **46**, No. 6, 1494; 1926, **48**, No. 1, 236.

[4] *Ibid*, 1926, **48**, No. 1, 195

[5] *Rec. trav. Chim.*, 1895, **14**, 204.

[6] *Annalen*, 1914, **403**, 206, 338.

Review of Current Technical Literature.

THE LAFEUILLE CRYSTALLIZER UNDER TRIAL IN JAVA.

G. E. van Nes and V. Khainovsky. Mededeelingen van het Proefstation voor de Java-Suikerindustrie, 1926, No. 5, 209-232.

This is an account of a very exhaustive series of tests made by two officials of the Java Experiment Station with the recently patented Lafeuille crystallizer[1], the special feature claimed for which is rapidity of cooling. The apparatus consists of a horizontal rotary cylindrical chamber, fitted with longitudinal tubes for cooling water, the circulation of which is so arranged that uniform cooling is obtained. Its inventor claims that it is possible to cool undiluted massecuites down to a temperature of 40°C. in 4-5 hours. In the first series of tests carried out by the authors at the s.f. Peterongan, Java, A-massecuites were treated, but as these had been been boiled as *dud* as possible (according to usual custom), it was necessary preliminarily to introduce into the crystallizer some 10 to 15 hectolitres of undiluted syrup (its capacity was about 150 h.l. or 3300 gallons), and to heat this up until all its false grain had been dissolved, before dropping in the dense massecuite. This having been done, the cooler was closed up, the rotary gear was put in motion at the rate of 1 rev. in 4 mins., and the water was turned on, its temperature being about 28°C. on entering, and about 20°C. below that of the contents on leaving. Proceeding in this way, it was found possible to lower the contents of the crystallizer from 78·2° to 40°C. in 4 hours 10 mins. With a molasses massecuite it was found that for a fall of from 78 to 43°C. as long as 17 hours was necessary, and even then a little false grain had appeared. In the case of first massecuites, however, these in general can be cooled down in 4-6 hours, and the syrup spun from them is better exhausted by about 5°. These are seemingly important advantages, but there is the matter of relative cost to consider. Two Lafeuille crystallizers would be required to cool down the first massecuites in a factory grinding 14,000 piculs (about 850 tons), each being 250 h.l. (5500 gallons), and the price of these would be about 50,000 florins (say £4170). But for this expenditure one could install two rapid-boiling pans of 250 h.l., capable of exhausting to a lower degree of purity in about 4 hours. It is therefore concluded that for first massecuites in the Java industry the use of the Lafeuille crystallizer can hardly prove remunerative. And that for molasses massecuites its installation is called for only when owing to want of sufficient room it is necessary to have a crystallizer plant having an increased output.

SOME REMARKS ON THE SIGNIFICANCE OF THE REACTION (HYDROGEN ION CONCENTRATION) IN REFINERY CONTROL.

I. M. Kolthoff[2]. *Archief, 1926, 34, No. 5, 130-134.*

According to H. Z. E. PERKINS[3] refinery liquors should show a *pH* of 6·4 to 6·8; J. A. GEBELIN[4] advises working at 7·2; whilst A. A. BLOWSKI and A. L. HOLVEN[5] say that one should hold to 7·0. But it seems to the author that the establishment of the true reaction of refinery liquors is not sufficient, and that one should bear in mind the following two points: Firstly, that the temperature at which the determination is made should be considered. If the dissociation constant of the water is equal to 10^{-14}, and one finds a *pH* of 7·0, then it means that the *pH* is the same as the *pOH*; but at 100°C. this is no longer the case, since the dissociation constant of the water strongly increases with rising temperature, being in fact at 100°C. equal to 10^{-12}, whilst those of the acids and organates also vary. Thus, one may have a liquor showing a *pH* of 7·0 and a *pOH* also of 7·0 at ordinary room temperature, but these values will be 6·7 and 5·3 respectively at 100°C. It is therefore of importance to determine the *pH* not only at room temperature but also at 100°C., for it is quite possible to have two liquors, both giving the same *pH* at room temperature, but, quite different values at higher degrees, which may explain certain irregularities heretofore often observed in practice. The second point to be considered is that there is an inclination at the present time to overestimate the importance of the H.I. Concentration, and to minimize that of the ordinary acidity by titration. As a matter of fact, the connexion between the two is of great value in sugar-house control, being a measure of the buffer effect of the liquor examined. If, e.g., an affined liquor which at room temperature has a *pH* of 7·0 and a *pOH* also of 7·0, but at 100°C. respective values of 6·7 and 5·3, then this means that glucose decomposition will occur at the higher temperature, at which degree acids will be formed and the hydrogen ion concentration will fall, a *pH* being finally reached at which glucose decomposition is practically arrested, and at which inversion no longer occurs. Optimum conditions are thus reached automatically. When two liquors having different buffer effects are compared, there will be more glucose decomposed in the liquor having the greater buffer intensity than in the other before arriving at the same *pH*. It appears, therefore, from these remarks that the solution of the question as to which *pH* is best to adopt in refining practice is by no means an easy one to answer. It is probably not possible to state any *pH* as the optimum for room temperature, as this must be determined in the case of each type of liquor in respect of its buffering intensity.

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[1] See U.K. Patent, 245,114; *I.S.J.*, 1926, 279; also U.K. Patent, 252,686.

[2] Pharmac. Lab. der Univ., Utrecht. [3] *I.S.J.*, 1923, 369. [4] *I.S.J.*, 1924, 51, 167.

[5] *I.S.J.*, 1926, 152.

(*A*) Report on Polariscopic Methods [Determination of Sucrose and Raffinose]. *F. W. Zerban. Journal of the A.O.A.C., 1926, 9, No. 2, 166-177.* (*B*) Report on Chemical Methods for determining Reducing Sugars. *R. F. Jackson. Ibid., 1926, 9, No. 2, 178-180.*

(*A*) In a previous report it was shown that in the analysis of sugar mixtures the Clerget divisor must be based not on the partial sucrose concentration, but on the total sugar concentration. It was also found that when the inversion is carried out at room temperature the methods of neutral polarization recommended by Jackson and Gillis,[1] and designated by them as No. II and No. IV, give correct results for sucrose and for mixtures of this sugar with pure invert sugar. But if reversion products are also present, then any method in which strong acid is used for inversion will at least partly hydrolyse the condensation products of reducing sugars. If the usual acid method is used, results too high are obtained even in the absence of reversion products, as is already well known. Further, it was pointed out that the use of high temperatures for inversion may—especially in the presence of acid—lead to further complications; if the product to be analysed contains invert sugar, inversion and reversion may go on simultaneously, and the equilibrium condition will depend on a number of factors, such as concentration of the various carbohydrates, temperature, time, and strength of acid. This work has now been continued, and summarizing what has been done, it is stated that: (1) When analysing sugar mixtures, the Clerget divisor must be based on total sugar concentration, and not on sucrose alone. (2) The rapid invertase method,[2] applied to sucrose and mixtures of it with invert sugar, either with or without reversion products, gives the same results as the standard invertase method at room temperature. The Clerget factor for both of these methods should be raised from 132·0 to 132·1. (3) As is already well known, the usual acid method at 67–69·5°, at 60°C., or at room temperature, gives too high results when invert sugar (or levulose alone) is present in any quantity. (4) The Jackson and Gillis methods of neutral polarization, Nos. II and IV, carried out at room temperature, give correct results for sucrose alone and for mixtures with pure invert sugar; but in the presence of reversion products the results are too high. The same conclusions hold for inversion at 60°, except that there is a tendency towards low results in the presence of pure invert sugar. In regard to the determination of sucrose together with raffinose in beet products, it is now recommended that the two-enzyme method of Paine and Balch[3] be adopted.

(*B*) As to the determination of reducing sugars, Nyns' method,[4] the principle of which is that Ost's solution (copper carbonate) is reduced at 48·5–49°C. by levulose alone, remaining unaffected by any sucrose or dextrose present, has been examined. It has been found by the author that, while he is unable to confirm the claim that the reagent is quite indifferent to the presence of glucose, he believes that it has sufficient merit to warrant an extended investigation. He finds that while about 3 mgrms. of levulose will reduce 10 mgrms. of copper, it requires about 50 mgrms. of dextrose to reduce 10 mgrms. of copper Consequently, if the analyst has even an approximate knowledge of the glucose content of his sample, he can correct for its reducing power with a fairly high degree of certainty. Eynon and Lane's method[1] is recommended for adoption as tentative, pending the verification of the tables.

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[1] *I.S.J.*, 1920, 175, 509, 570, 638. [2] "Methods of Analysis of the A.O.A.C.," 186, 22 (*C*).
[3] *I.S.J.*. 1925, 276. [4] *I.S.J.*, 1925, 163.

BASIC-DYES AS FLOCCULATING AGENTS FOR APPROXIMATE QUANTITATIVE DETERMINATION OF COLLOIDS IN SUGAR-HOUSE LIQUORS. *M. S. Badollet and H. S. Paine. Additional Communication to this Journal.*

These authors wish to make a correction in the third instalment of their article.[2] In the penultimiate paragraph on page 139, the portion reading: "Then slowly lower the objective . . . The electric current should not be allowed to pass between the electrodes while this adjustment is being made." should be omitted. Because of the electro-osmotic movement of an aqueous solution in a capillary tube, it is desirable, in order to measure the true speed of the colloid particles, to focus the microscope at a point in the capillary at which the electro-osmotic movement of the liquid is nil. This point as found by MATTSON is obtained by focusing at a distance of $0 \cdot 293 \times r$ (r = radius of capillary) below the upper wall of the capillary. The data recorded in their paper were obtained by focussing in this manner. The authors take advantage of the opportunity to express again their indebtedness to Dr. S. E. MATTSON, of the Bureau of Soils, U.S. Department of Agriculture, to whom the cataphoresis apparatus and technic used in the work are due.

PURIFICATION OF BEET DIFFUSION JUICE, USING PROTEOLYTIC ENZYMES (PEPSIN, ETC.). *Herman Schreiber. Industrial and Engineering Chemistry, 1926, 18, No. 8, 860-864.*

In the carbonation process of purifying juice in the sugar factory, an important effect of the comparatively large amount of lime added is to hydrolyse certain of the nitrogenous constituents, one of the end-products of which decomposition is evident throughout the factory, namely, ammonia. It had occurred to the author that this degredation of the proteins might be accomplished, and possibly the conversion rendered more complete, by using a proteolytic enzyme, such as pepsin[3], and on putting this idea to the test by purchasing some *liquor pepticus* at a drug store, and adding it to slightly acid beet juice, he was able to observe a good rise in the purity, even without any further treatment. However, it was proved advantageous to supplement the treatment by carbonation, using only a fraction of the amount of lime ordinarily employed, the method of operating used in the laboratory being as follows: To 1500 c.c. of diffusion juice heated to 52°C., 10 c.c of a solution of 0·1 grm. of pepsin in 100 c.c. of water was added, and the liquid allowed to stand for 15 minutes, as the result of which treatment the purity was found to have risen 3°. At the end of the time mentioned, the solution was heated to 70-80°C., treated with 25 c.c. of 20 Bé. milk-of-lime and carbonated to say 10-15 c.c. of N/28 acid, using phenolphthalein. Then the liquid was filtered, heated to 70-95°C., carbonated to 1-2 c.c. of N/28 acid, and finally filtered, when it was found that the purity had increased 5° in all. Great economies in working by this process (which has been patented[4]) are predicted by the author. Thus in purifying the juice from say 60 tons of roots, 1 lb. of pepsin, and less than 1 ton of limestone and coke, are required, as compared with present practice in which about 4·2 tons of stone and 0·42 ton of coke are handled. This means 1·2 tons of lime-cake by the new method against 6 tons by the present process (using 2·5 per cent. of CaO on beets). Washing 1·2 tons of cake requires 1·8 tons of water, against 9 tons of water for 6 tons of cake, so that there are about 13 tons less water to evaporate per 63 tons of roots, this meaning an increase in the evaporator capacity of 13·8 per cent., a saving of 0·4 ton of coal, and so on. But the pepsin process lowers the lime-salts, produces a higher yield of sugar, and gives clean-smelling molasses, possibly edible. Extra equipment for a 600-ton house would only consist of two heaters, several pumps and wooden tanks, while the pepsin would cost only about $2 per lb. Operations appear to have been carried out by the author on a semi-technical scale, and the following are some of the results obtained last crop in one of the American beet houses :—

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[1] *I.S.J.*, 1923, 143, 305. [2] *I.S.J.*, 1926, 137-140.

[3] Pepsin acts only in acid solution. Trypsin, which also is an enzyme hydrolysing albuminoids, is able to effect the conversion only in neutral or alkaline solution. Trypsin does not appear to have been experimented with by the author, though he appears to have tried rennet. Trypsin carries the hydrolysis further than rennet.

[4] U.S. Patent, 1,581,663; taken out by HERMAN SCHREIBER, of Lansing, Mich., U.S.A., filed May 23rd, 1925, published April 20th, 1926.

Description of Juice	CaO on Beets, Per cent.	Cost of CaO per Ton Beets, Cents.	Pepsin per Ton Beets, Grms.	Cost Pepsin (at $1.80 per lb). Cents.	Total Cost of Purif'g per Ton Beets, Cents.	True Purity Direct Pol., Per cent.	Total Nitrogen, Per cent.	Lime Salts in Thin-juice.
3rd carb'n from house	4.00	32.0	—	—	32.0	87.6	0.65	0.041
2nd carb'n by pepsin	1.00	8.0	19.6	7.8	15.8	87 9	0.67	0.037
3rd carb'n from house	4.75	38.0	—	—	38.0	82.1	0.62	0.062
2nd carb'n by pepsin	1.00	8.0	19 6	7.8	15.8	82.9	0.62	0.048
3rd carb'n from house	4.00	32.0	—	—	32 0	80.5	0.62	0.098
2nd carb'n by pepsin	1.00	8.0	19.6	7.8	15.8	81.2	0.66	0.087
3rd carb'n from house	5 00	40 0	—	—	40.0	83.3	0.63	0.066
2nd carb'n by pepsin	1.00	8.0	24.5	9.7	17.7	84.9	0.69	0.052
3rd carb'n from house	5.00	40.0	—	—	40.0	80.1	0.66	0.106
2nd carb'n by pepsin	1.20	9.6	24.5	9.7	19.3	79.1	0.76	0.086
3rd carb'n from house	5.00	40.0	—	—	40.0	79.0	0.68	0.134
2nd carb'n by pepsin	0.90	7.2	24.5	9.7	16.9	78.8	0.78	0.115

POSITION OF CONTINUOUS JUICE EXTRACTION FROM BEETS. *Berthold Block, and others. Deut. Zuckerind., 1926, 51, No. 15, 405-408.* Dr. BLOCK having stated that the "Rapid" and Philipp-Forstreuter processes have certain disadvantages, as demanding a greater juice draught, more floor-space, and a higher initial cost, these points were controverted by H. GIESELER, K. PHILIPP and Dr. PILLHARDT, who emphasized the rapidity of operation, and low sugar exhaustion realized by these methods. Two "Rapid" plants are now in operation in Germany, and four others in course of construction.—ELECTRICAL EQUIPMENT IN BEET FACTORIES IN THE U.S.A. *W. A. Mitchell. Facts about Sugar, 1926, 21, No. 20, 473, 475.* Gives some details of the electrical plant of Ovid and Minatare factories and of the Johnstown molasses plant.—"NORIT" PROCESS AT DINTELOORD, HOLLAND. *Berthold Block. Deut. Zuckerind., 1925, 50, 1650-1652; 1926, 51, 113-118, 322-325, 377-380, 409-412.* A very detailed account is given of carbon refining in this factory, which produces 400-450 tons of sugar per day mostly for the English market.—PREPARATION AND COLLOIDAL PROPERTIES OF PECTIN. *Mary A. Griggs and Ruth Johnstin. Ind. and Eng. Chem., 1926, 18, No. 6, 623-625.* "It seems probable that with a standard method of preparing pectin free from impurities, reproducible and valuable results can be obtained. A thorough knowledge of the colloidal behaviour of pectin sols must furnish the scientific basis of the commercial utilization of the enormous quantities of pectin now available."—pH DETERMINATION WITH THE QUINHYDRONE ELECTRODE. *L. E. Dawson. Sugar, 1926, 28, 262-264, 310-312.* Apparatus described by FARNELL[1] is criticized with the remark that in this design "the saturated KCl solution used for a bridge solution would quickly contaminate with the solution to be measured, especially if the platinum electrode were in the position shown in his illustration. It might also be difficult to keep the solution to be measured from passing at once into the calomel electrode unless the solution had approximately the same density as the KCl solution." J. P. O.

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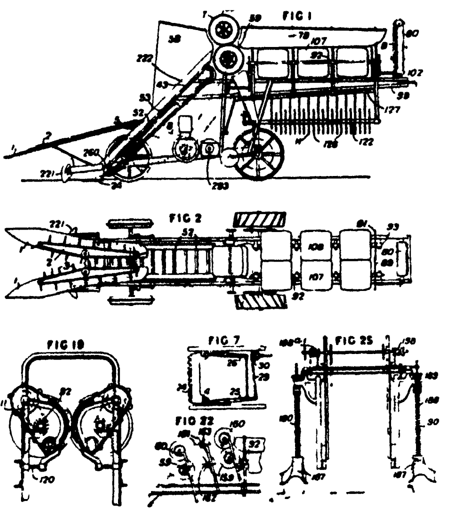
[1] *I.S.J.*, 1925, 141-146.

Review of Recent Patents.[1]

UNITED KINGDOM.

Cane Harvester.* *R. S. Falkiner*, of Melbourne, Australia. *251,739*. March 23rd, 1925.



Cane is directed towards a reciprocating cutter by gathering arms *1* provided with endless chains *2* carrying fingers *3* and driven by bevel gear *5* and a chain *8* from a countershaft *293*. The arms *1* are adjustably mounted at both their inner and their outer ends. The cutter bar *24*, Fig. 7, is reciprocated by levers *25*, *26*, connected together and driven by a connecting rod *29* coupled to a crank *30* actuated from a power shaft. Shoes *41* on the cutter bar protect the ends of the levers *25*, *26*, from impact with the soil. Approximately rectangular rotary cutters may replace the reciprocating cutter. The ground is cut, to facilitate the operation of the cutter *24*, by freely rotatable discs *221* set at an angle to the line of draught. The cut cane falls upon an elevator consisting of endless chains *43* carrying slats *52* formed with harrow teeth *53* bent forwardly towards the elevator surface. Side boards *222* and a hood *58* guide the cane in its passage up the elevator and a guard *260* prevents the butts of the cane being engaged by the elevator until the cane is in an inclined position and also protects the base of the elevator from stones or like obstacles. The elevated cane is engaged, tops first, by rollers *59*, *60* that throw the cane longitudinally against a stop *B* One or both rollers are positively driven and each roller has a resilient tread *T* either pneumatic or formed by a thick layer of spongy rubber. A solid flexible tread may be provided, the one roller in this case being pressed against the other by a spring. A hood *79*, that may be either stationary or formed by a travelling belt, directs the cane towards the stop *B*. This stop may consist of a rearwardly and downwardly inclined plate or, as shown, of a vertically travelling endless apron *80* that is carried in a frame adjustable along an horizontal frame *99* by a hand-wheel *102*. The cane falls upon a pair of oppositely rotating cutting discs *89*, *91*, mounted on shafts *92*, *93*, one or both of which are positively driven and both of which carry resilient rollers *107*, *108*, adapted to engage each other. Other rollers may be fitted behind the discs *89*, *91*, to discharge the cut tops. Loose trash may be removed from the cut cane by blasts of air directed upwardly between the rollers from pipes in connexion with blowers, such trash being carried to the rear of the machine. The topped cane falls into a hopper *H* which is discharged at intervals into trucks or upon the ground at either side. When it is desired to cut the cane into short lengths extra cutters are fitted on the shafts *92*, *93*. The cane may be discharged downwardly by a pair of positively driven slatted aprons *111* that are pressed towards one another by springs *120*. The hopper *H* may have a base composed of a series of transverse rods projecting on both sides of a longitudinal rock-shaft *122* controlled by a hand-lever so that it may be inclined to dump the cane on either side of the machine. The sides of the hopper consist of curved rods *126* mounted on rock shafts *127* that may be moved to allow the cane to slide off the base of the hopper. In a modification the cane falls into a hopper formed by concavely-curved transverse rods, and after the hopper is filled ropes are stretched below the cane and attached above it to winding drums that are then actuated from a power shaft, thus ejecting the cane to one side. Canvas-lined wire mesh may replace the ropes below the cane. The trash may be stripped from the cane by radial tines *161* extending from transverse shafts *162*, *163*, rotating in the opposite direction to the throwing rollers *59*, *60*, behind which the shafts *162*, *163*, are situated, an extra pair of throwing rollers *159*, *160*, being arranged in the rear of the stripping shafts. In an alternative arrangement the stripper shafts are arranged longitudinally between the two pairs of throwing rollers. In a further arrangement the stripping device comprises wire bristles arranged tangentially on drums rotating in front of the main throwing rollers. The machine may be propelled by creeper chains passing round wheels carried in a frame *187* upon which the elevator frame and its associated parts are supported by rods *188*. The upper ends of these rods are screwed and the elevator frame is adjustable along these rods by the rotation of nuts *189*. These nuts are adapted to be rotated from the power shaft, clutches *198*, *198ᵃ* being adapted to be thrown in according as the frame is desired to be lifted or lowered. A trip lever actuated by limit stops automatically throws out the clutch when the desired position is reached. Springs *190* assist the lifting operation. When the machine is carried upon ordinary wheels the front of the frame is carried by the rods *188* engaging with the horizontal shanks of double-ended cranks carrying the front wheels, these shanks passing through slots in the elevator frame.

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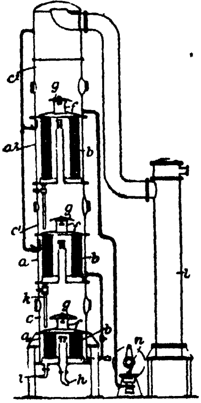
[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. 2 (price 1s. each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal (Patents)*, with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris *Germany*: Patentamt, Berlin, Germany.

EXTRACTION OF SUGAR FROM MOLASSES BY THE CALCIUM SACCHARATE PROCESS.[1] *Carl Steffen*, of Vienna, Austria. *252,110*. August 1st, 1925; convention date, May 18th, 1925.

Tricalcium saccharate, rich in sugar and poor in lime and of high purity, is obtained by mashing tricalcium saccharate, obtained from a molasses solution, into a cold low percentage sugar solution, one and a half to three-fold the quantity of sugar in the sugar solution being added in the form of saccharate, fine lime powder being next added to precipitate the calcium saccharate dissolved in the mixture, and the saccharate then separated, for example by filter-pressing.

SUPERIMPOSED MULTIPLE EFFECT EVAPORATOR. *Blair, Campbell & McLean, Ltd.*, *and J. R. Phillips*, of Govan, Glasgow. *252,505*. April 4th, 1925.

FIG I



In a piled multiple effect apparatus comprising a series of elements of the separate heater and evaporator type, the liquid passes from the heaters *a*, *a*¹, *a*², to the evaporating chambers *c*, *c*¹, *c*², through tubes *f* surmounted by deflectors *g* which are adjustable in height so as to vary the extent of the annular openings. The tubes *f* and the deflectors *g* may be corrugated The lowest heater *a* is heated by steam supplied to its casing by a tube *h*, and the other heaters by vapours evolved in the evaporating chambers below them. Liquid to be evaporated is supplied by a pipe *i* to the bottom header of the heater *a*, and rises through the tubes *b* to the upper header from which it passes through the annular opening between the tube *f* and the deflector *g* into the evaporating chamber *c*. The partially concentrated liquid is forced or drawn through a pipe *k* into the second heater *a*¹. Concentrated liquid is withdrawn from the upper chamber *c*² by a pump *n*. Steam or vapour is drawn from the chamber *c*² by a pump to a condenser *l*.

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[1] See also *I.S.J.*, 1925, 228, 450, 632.

Patents.

Mill Pressure Gear.* *Schneider & Cie.*, of Paris, France. *252,322.* January 22nd 1926; convention date, May 23rd, 1925.

Relates to means for tightening the rolls of sugar cane shredders or mills of the kind in which a piston *D* moving in a sleeve or lining *G* of the cap or cover *E* of the roll bearing is forced by liquid under pressure against the upper bearing *a*. To obtain a tight joint between the piston *D* and lining *G*, the piston *D* is fitted with an auxiliary piston *L* moving in a cavity D^3 and having a flange L^1 which transmits the pressure of the oil, etc., to a rubber ring *M* on a shoulder d^1 of the piston *D*, the ring *M* transmitting the pressure radially through rubber segments *N* located in cavities in the piston *D* to a rubber ring *O* which bears upon a packing-member *P* made of plastic material and held between bronze rings D^1, D^4 on the piston *D*. The bell-shaped member *I*, which is held upon a shoulder *g* of the removable lining *G* by a nut *J*, has a flange *i* at its lower part, and annular joint-packing *Q* of plastic material is arranged between the flange and the inner face or edge of the nut. A spring *R* is arranged between the bell *I* and the piston *L*. A spur *H* fixed on the cover *E* projects into a groove *d* of the piston *D* and prevents the piston from rotating; the spur may serve as a distribution duct for the lubricating oil for the surface of contact between the piston and the spherical bushing on the bearing *a*. Oil under pressure is supplied by a pipe *k*, the inner end of which is expanded to form a head, and packing S^1 is provided between the head and the lining *G*.

FIG 3.

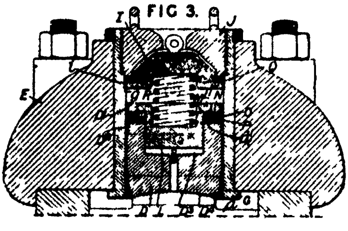
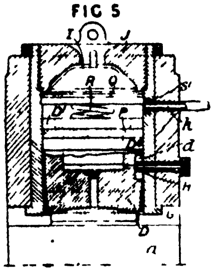


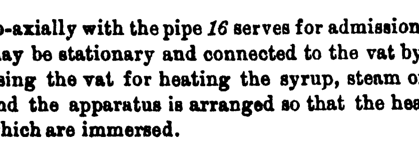
FIG 5



Massecuite Crystallizing Apparatus. *F. Lafeuille*, of Paris. *252,686.* April 15th, 1926; convention date, May 20th, 1925.

A horizontal rotary cylindrical vat of the kind described in Specification 245,114[1] for crystallizing sugar or other solutions is fitted with means to enable it to be used for heating the solution or for evaporating *in vacuo*. The vat *1*, at the end opposite to that carrying the supply and discharge fittings *9*, *11* for the cooling medium to the tubes *6*, is fitted with a drum *18*, which rotates with the vat and which contains an up-turned stationary pipe *16* connected to a vacuum pump. A hood *19* prevents entry of entrained liquid into the pipe. A pipe *20* entering the vat co-axially with the pipe *16* serves for admission of syrup to the vat. Alternatively, the drum may be stationary and connected to the vat by a stuffing box in which the vat rotates. In using the vat for heating the syrup, steam or hot water is passed through the tubes *6*, and the apparatus is arranged so that the heating-agent passes only through those tubes which are immersed.

FIG 3



Maceration Process in Cane Milling. *F. Kessler*, of San Fernando, Buenos Aires. *250,889.* June 12th, 1925; convention date, April 18th, 1925.

In the extraction of the juice from cane or bagasse, water, or dilute sugar solution, is uniformly distributed through the material by the aid of a gaseous fluid, for example a blast of air, steam or inert gas or vapour. Cane may be fed to rollers *a* where as much juice as possible is extracted; bagasse issuing from these rollers *a* is loosened and fed on a shoot or sliding plate *c* to extraction rollers *d*. After leaving rollers *a*, a portion of the solvent may be sprayed on the bagasse from a plurality of nozzles *f*, the bagasse then passing under a spring-journaled roller *g* where it is slightly compressed. It next passes under a box *h* the bottom of which has a number of nozzles through which air, steam, etc., is blown. It may then pass under another nozzle arrangement f^1 for the solvent, a second box h^1 for the air, steam, etc. treatment, and a pressure roller g^2, to the rollers *d*. The solvent may also be admitted in vapourized form through perforations in the shoot *c* from a box *k*, and condensing within the material may constitute the solvent, or it may be introduced simultaneously from above in liquid form and from below as a vapour. Rollers *g*, g^1, g^3 may be provided with shoulders, cams or other projections and serve for the propulsion of the bagasse. Clarifying reagents may be added to the solvent.

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[1] *I.S.J.*, 1926, 279.

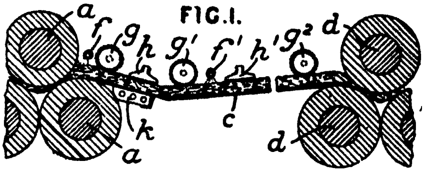
FIG. 1.

PRODUCTION, APPLICATION, AND REVIVIFICATION OF ACTIVATED (DECOLORIZING) CARBON. (*A*) *E. Urbain*, of Paris. *249,138*. March 11th, 1926; convention date, March 12th, 1925. (*B*) *I. G. Farbenindustrie A.-G.* (assignees of *Farbenfabriken vorm. F. Bayer & Co.*, of Leverkusen, Cologne, Germany). *251,636*. April 28th, 1926.

(*A*) Charcoal suitable for use in refining sugar is prepared by drying and calcining a preferably agglomerated mixture of any vegetable substance with dicalcium phosphate and sulphuric acid; but the addition of acid may not be necessary in certain cases. The granular product may be made into a paste by crushing and washing on a filter with hydrochloric acid and water, and the paste may be dried and sifted to obtain a fine powder. Suitable initial materials are peat, wood, straw, corozo nut, starch, glucose, and lignite. (*B*) Carbonaceous materials, such as wood, peat or lignite are treated with sulphuric acid at elevated temperature, and steam is then passed through the material whereby active carbon is obtained. In an example, a homogeneous mixture of peat and sulphuric acid is pressed into any desired shapes and heated in a shaft, revolving or other type of furnace. Active carbon is produced on passing steam at a somewhat higher temperature.

CONFECTIONERY. (*A*) *J. B. Mattson*, of Minneapolis, U.S.A. *248,773*. March 6th, 1926; convention date, March 7th, 1925. (*B*) *Gruyère Usines Laitieres Soc. Anon.*, of Epagny, Gruyères, Switzerland. *248,391*. February 27th, 1926; convention date, February 27th, 1925. (*C*) *P. Kaiser*, of Dresden, Germany. *250,951*. April 14th, 1926. (*D*) *L. C. J. Davis, T. H. Appleton, and P. Kerr*, of Regent Street, Sheffield. *252,046*. November 6th, 1924. (*E*) *Macao-Walzenmühlen Ges.*, of Hamburg, Germany. *253,059*. April 14th, 1926.

(*A*) A decorating bag, for confectionery, is provided with a removable liner, preferably of paper. (*B*) For use in making milk or cream chocolate, or other substances such as pralines, milk, enriched if desired in fat content, is evaporated in vacuum apparatus until a milky mass practically free from water is obtained, this mass being then moulded into bars or blocks while still warm. (*C*) In the preparation of chocolate, the cocoa beans are fed to a sorting machine, from which they pass through a roasting chamber, a shelling, breaking and cleaning device, a mixing device, where the sugar, with other added substances such as nuts, are added thereto, and a rolling mill, the mass being subsequently ground, refined, and formed into tablets, and the like. (*D*) A collapsible tube for use in the decoration of confectionery and other edibles is provided with a detachable nozzle having an elliptic orifice, the nozzle being fitted after the removal of the usual preserving-cap. (*E*) In apparatus for milling chocolate and like plastic materials of the type comprising planetary rolls rotatable around a central roll and also on their own axes, some or all of the planetary rolls and also, if desired, the central roll, are formed with through-passages or gaps so that the material can pass transversely through the longitudinal axes thereof.

ALCOHOL MOTOR FUEL. *I. G. Farbenindustrie Ges.*, of Frankfort-on-Main, Germany. *251,969*. April 27th, 1926. Motor spirit consists of gasolene with an addition of methyl alcohol, preferably anhydrous. A blending agent, e.g. higher aliphatic alcohols or ketones, or hydrocarbons of the benzene series, may be added. In example, to 88 litres of gasolene are added 12 litres of crude synthetic methanol which comprises isobutyl alcohol; or 4 litres of anhydrous methyl alcohol are added to 96 litres of 0·75 gasolene.—PRODUCTION OF YEAST FROM MOLASSES, ETC. *International Yeast Co, Ltd.*, of Pall Mall, London. *252,193*. May 14th, 1926. In yeast-manufacturing processes involving the continuous addition of concentrated wort to the mash during fermentation, and the continuous withdrawal of yeast-containing liquor therefrom at the same rate, main and auxiliary fermenting vats are provided, the concentration of the wort being greater in the main than in the auxiliary vats.—PRODUCTION OF GAS OF HIGH SULPHUR DIOXIDE CONTENT. *S. G. S. Dicker* (Communicated by *K. Kudoh*, of Osaka, Japan). *252,928*. July 17th, 1925. A gas rich in SO_2 may be produced by burning sulphur in an atmosphere consisting of SO_2 and at least 22 per cent. of oxygen.—BEET ROOT HARVESTER. *Soc. Anon. Labor.* and *P. W. Lenaers*, of Liège, Belgium. *251,538*. April 17th, 1925. Root crops, such as beet, are lifted by a plough and pass to a cleaning device comprising four rollers provided with hook-like prongs and all rotated in the same direction by chains driven from the main axle of the plough frame. The rollers are grooved, the prongs of one roller being opposite the grooves on the next; and they are carried in a frame secured to the plough frame by a pivot and provided at its rear end with suspending chains, by which its inclination is adjustable. To discharge the cleaned roots at either side a conveyor frame is hung by arms on a bar carried on the roller frame, the conveyor being adapted to be put out of action by swinging the frame about a bar as pivot by a chain. The conveyor comprises a series of articulated bars forming a chain passing over sprockets which at the one end are mounted on a shaft driven through bevel gear from the shaft of the end roller. To reverse the direction of travel of the conveyor the shaft of the roller is extended and its bevel wheel fitted the other way round. Two ploughs may be arranged on one machine.—ALCOHOL MOTOR FUEL. *A. P. Mackilligin and F. Garland*, of Perak, Malay States. *251,157*. August 19th, 1925. Motor spirit comprising alcohol, ether, and a basic substance such as pyridine, aniline, or ammonia is further denatured by caoutchoucine, a liquid obtained by distilling crude plantation rubber at about 176°C. or higher. A suitable fuel consists of 55·0 litres of alcohol, 43·0 of ether, 0·5 of pyridine, 0·5 of caoutchoucine, and 1·0 litre of kerosene.—CENTRIFUGAL MACHINES. *T. Broadbent & Sons, Ltd., and H. Broadbent*, of Huddersfield. *251,390*. March 10th, 1925. A centrifugal machine used for separation, clarification, and the like, has a cage on a vertical shaft driven by overhead motor and revolving in a self-aligning bearing carried by the upper part of the framework. Bottom end of the shaft is supported in a double thrust and roller bearing, housed in a rubber or other flexible buffer, carried in a casing, which is slung by three suspension bolts, on columns from the foundation plate.—SAND FILTER. *C. R. B. Brown*, of Wood Green, London. *251,398*. March 16th, 1925. Rake prongs for agitating the sand bed during cleansing are fixed to horizontal arms which are pivoted to a main arm on a rotary spindle.—PRODUCTION OF ALCOHOL AND ACETONE BY FERMENTATION. *E. H. Strange*, of Staple Inn, London. *251,678*. January 10th, 1925. A mash suitable for the production of ethyl alcohol by the action of yeast is treated with yeast and with an organism, such as the butylic bacillus of Fitz, capable of producing butyl alcohol and acetone, the two fermentations then proceeding simultaneously. The ferments may be added to the mash at the same time or otherwise. The mash may consist of molasses and/or of starchy material prepared for use in known manner; alternatively, it may consist wholl or in part of Jerusalem artichokes the carbohydrate content of which has been previously hydrolysed.—Filtration of Liquors. ***M. Russell***, of Greenock, Scotland. *251,749.* April 4th, 1925. Filtering plant, in which the filtering medium is revivified by superheated steam as described in Specification 210,232,[1] is provided with a steam-compressing pump or turbine arranged to draw the hot gases from the filter during revivification and pass them through a superheater for return to the filter, so that after starting live steam from the boilers is only required to make up losses.—Dehydration of Alcohol. ***Distilleries des Deux-Sèvres***, of Melle, France. *253,128.* June 3rd, 1926; convention date, June 4th, 1925. In dehydrating alcohol by distillation in presence of a liquid which yields a azeo-tropic mixture, provision is made to separate the higher boiling impurities which remain in the alcohol. Apparatus is specified for so doing.—Valves. ***Mirrlees Watson Co., Ltd., W. A. Dexter, and D. T. McHutchison***, of 45 Scotland St., Glasgow. *253,301.* April 24th, 1925. A valve device for maintaining a constant pressure on the inlet side and particularly adapted for use in connexion with centrifugal pumps comprises a partly balanced piston valve member loaded by dead weights. The valve, which works in a ported liner, is provided with a stem passing to the outside of the casing where it is fitted with a table for dead weights. The space above the piston is connected to the inlet side of the valve through a port adjustably throttled by a needle valve, which gives a dash-pot effect and reduces the necessary load. To prevent hunting due to inertia effects, the underside of the valve is made approximately conical.

UNITED STATES.

Concentration of Solutions by Freezing. ***Maxwell O. Johnson***, of Waipio, T.H. *1,576,136.* March 9th, 1926.

Disadvantages inherent to concentration by evaporation are obviated in concentration by freezing, while also certain features of easy and rapid separation of the concentrated fluid are realized, together with capacity for maintaining a continuous process, and also for employing regenerative steps or means which render the process easy, rapid and economical. An apparatus is provided for freezing in a tank or other suitable container of heat-conducting material, one level of the container being subjected to freezing temperature, and another being maintained above the freezing temperature, the aqueous or other more dilute part of the solution being frozen within the container and the condensed residue of the solution collecting in that part of the container which is maintained above freezing temperature. As embodied, a refrigerating medium is applied to the exterior of a part of the tank or compartment, and preferably to the upper part thereof, and the lower part is maintained above the freezing temperature. The aqueous or other thin part of the solution in such a tank or container under these conditions, will freeze out in an almost pure condition as ice on the sides or walls, while the greater part of the concentrated solution, which is of greater specific gravity than the dilute solution, will settle into the bottom or non-freezing portion. When the desired or required degree of concentration is reached, the concentrated fluid or solution may be drawn off without disturbing the ice or frozen part of the original dilute solution. This will remove the greater part of the concentrated solution; but, by allowing the portion of the tank or compartment which was subject to freezing to rise in temperature above the freezing point, the ice in the tank will gradually thaw or melt, and the remainder of the concentrated part of the solution (which is of intermediate concentration between the very dilute and highly concentrated parts) will come off in the first draining, as it forms a softer or "mushier" ice. Practically all of this string-concentrated solution may be drained off before the purer or harder ice begins to melt and at this time almost pure ice is left in the tank or container, and the concentrated juice is practically entirely drained off, thus effecting an easy, rapid, economical and complete separation of the two. If desired, th blocks of ice formed in the tank may be thawed loose, lifted out, broken up and centrifuged to recover the relatively small residue of concentrated juice. This, however, is usuall unnecessary where the draining, thawing and again draining process as just described is employed. The pure ice secured may be broken up and used in a regenerative process described in this specification.

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[1] *I.S.J.*, 1924, 223.

PRODUCTION, REVIVIFICATION AND APPLICATION OF ACTIVATED (DECOLORIZING) CARBONS. (*A*) *Harold L. Kauffman*, of Parco, Wyo., U.S.A. *1,579,326.* April 6th, 1926. (*B*) *Gustavus J. Esselen, Jr.* (assignor to *The United Fruit Co.*, of Boston, Mass., U.S.A.). *1,575,661.* March 2nd, 1926. (*C*) *Paul Wöhler*, of Mannheim, Germany (assignor to the *Rhenania Verein chemischer Fabriken A.-G.* *1,588,868.* June 15th, 1926. (*D*) *Rudolf Adler*, of Carlsbad, Czecho-Slovakia. *1,589,081.* June 15th, 1926. (*E*) *Wm. H. Hoodless*, of Philadelphia, U.S.A. (*a*) *1,589,531* ; (*b*) *1,589,532.* June 22nd, 1926. (*F*) *Hugh Rodman* (assignor to *Rodman Chemical Co.*, of Pennsylvania, U.S.A.). *1,591,235.* July 6th, 1926. (*G*) *Chas. B. Davis*, of New York. *1,592,599.* July 13th, 1926.

(*A*) Claim is made for the use of a decolorizing agent having as its base the mineral leverrierite. (*B*) Consists in digesting the pithy component of cane or bagasse with an alkaline reagent, e.g., caustic lime, heating to 80-100°C., and carbonizing at 800-900°C., the product thus obtained being ready for use without acid extraction. It can be revivified by merely washing with water and heating to 800°C., or higher. (*C*) Active carbon in granular form is made by carbonizing under exclusion of air at a temperature of 300 to 600°C. wood in bits of small size, in incorporating alkali in the product, and in heating the product under exclusion of air at bright red heat. (*D*) A medicinal charcoal preparation in compressed body form consists of a mixture of powdered adsorptive charcoal and a plastic clay. (*E*) (*a*) Claim is made for the process of producing kieselguhr the internal structure of which is lined throughout with finely divided decolorizing carbon in the form of a thin film which comprises making an intimate mixture of dry kieselguhr and dry sawdust confining this dry mixture in a retort closed except for a small opening, heating this mixture so confined until a combustible vapour is generated and passes off through the opening, and continuing this heating with the maintenance of the same temperature and the generation of the vapour until the vapour is no longer given off. (*b*) Also or an improved filtering and decolorizing material consisting of kieselguhr the porous interior structure of the particles of which is covered with a thin layer of carbon from heat charred molasses. (*F*) A method of activating carbon consists in heating it to an activating temperature by direct contact with the hot gases derived from burning fuel and agitating the carbon. (*G*) Synthetic bonechar comprises a carbonized mass from decomposed non-saccharine, non-fibrous, non-starchy organic matter, natural to raw sugar.

TREATING BEET DIFFUSION JUICE. *Harry S. Thatcher and Samuel E. Josi*, of Chicago, Ill. (assignors to *The Celite Co.*, of Los Angeles, Cal.). *1,586,486.* May 25th, 1926. 1 :—In the manufacture of beet sugar by the diffusion process, the method of purifying diffusion juice which comprises heating such diffusion juice, forming on the filtering surfaces of a filtering apparatus a coating of diatomaceous earth by passing through such apparatus a suspension of diatomaceous earth in purified beet juice, and then passing such heated diffusion juice through said coating of diatomaceous earth.—PRODUCTION OF ABSOLUTE ALCOHOL. (*A*) *John A. Steffens* (assignor to the *U.S. Industrial Alcohol Company*). *1,586,717* and *1,586,718.* June 1st, 1926. (*B*) *Elwood I. Clapp* (assignor to *U.S. Industrial Alcohol Company*). *1,586,732.* June 1st, 1926. The first specification relates to a process of distillation of an alcohol, water, and a liquid immiscible with water to form a constant boiling mixture, giving absolute alcohol at the bottom of the column ; the second relates to the apparatus used in this process ; and the third comprises the process of supplying same apparatus with a mixture of the three components mentioned, the ratio of the low-boiling hydrocarbon to water being "between a point above 10·5 to 1, and 17 to 1."—BEET HARVESTER. *Wm. V. Seifert*, of Denver, Colo., U.S.A. *1,587,243.* June 1st, 1926. Claim 4 :—A beet harvester comprising a framework, ground wheels supporting the framework, to endless flexible members supported to travel on the framework in proximity and having twisted portions and means for imparting travel to the said members from the ground wheels of the machine. SCALING PREVENTION. *George S. Neeley*, of Wood River, Ill., U.S.A. *1,579,453*. April 6th, 1926. Method described consists in connecting one terminal of an electric circuit to the metal portion of the steam boiler, at a point which is located at or near the lowermost portion thereof, connecting the other terminal of said circuit to a single conductor located in and near the top line of the water contained in said boiler, and insulated from the latter, whereby said boiler and said water are electrically energized by an external source of electrical energy.—REFRACTOMETER. *Otto Henker*, of Jena, Germany. *1,579,532*. April 6th, 1926. Claim is made in an apparatus, for the purpose set forth, for a source of light, a collective lens system, a diaphragm located between the source of light and the lens system and adapted to be imaged by the lens system in the pupil of the eye to be observed.—RECOVERING CALCIUM HYDRATE IN THE SACCHARATE METHOD OF EXHAUSTING MOLASSES. *George M. Drummond* (assignor to *Holly Sugar Corporation*, of Colorado Springs, Colo., U.S.A.). *1,580,024*. April 6th, 1926. Claim is made in a process of recovering calcium hydrate from cold saccharate obtained in a process of recovering sugar from molasses for the method of separating calcium hydrate from a liquid in intermixture therewith, which comprises continuously introducing the liquid mixture into what is known as positive pressure or vacuum thickeners, the clear liquid continuously flowing from same, and removing the precipitate from the bottom and filtering the precipitate, the filtering medium in said thickener being completely submerged at all times.—RECOVERY OF AMMONIA FROM VINNASSE (DISTILLERY WASTE). *Gaston P. Guignard*, of Melun, France. *1,576,427*. March 9th, 1926. A process of recovering ammonia from vinasses, which consists in heating, at a temperature between 450 and 550° Centigrade and under vacuum, a vinasse containing water, said temperature and vacuum being maintained during the whole treatment.—ALCOHOL MOTOR FUEL. *Robert A. Carroll and Henry L. Elliott*, of Buffalo Township, Pa. *1,587,899*. June 8th, 1926. Claim is made for a blended motor fuel comprising aromatic hydro-carbon distillates substantially free from sulphur, and having boiling points not over 300°F., petroleum distillates having boiling points not over 300°F., a lower, readily volatile monohydric alcohol, a readily volatile terpene compound, naphthalene and water, the last-mentioned four being together equal to not over about 7 per cent. of the entire mixture, such product being in the form of a homogeneous stable mixture.—EVAPORATOR. *Martin J. Kermer*, of Evanston, Ill., U.S.A. *1,588,029*. June 8th, 1926. An evaporator comprises a vertical cylinder open at both ends, to contain material to be dehydrated ; a jacket surrounding the cylinder to contain steam ; means to rotate the cylinder and jacket and centrifugally operating outwardly flared open annulus to deposit said material upon the inner surface of the cylinder.—CANE CULTIVATOR. *Grover W. Burdin and Maurice J. Landry*, of St. Martinsville, La., U.S.A. *1,588,306*. June 8th, 1926. A cane cultivator comprises a frame, supporting wheels therefor, and off-barring earth working elements carried by said frame, of a pair of horizontal angularly disposed shaver blades carried by said frame in advance of said off-barring elements, adapted to shave off the top of a row of plant canes, stubbles, and the like ; a coulter wheel carried by said frame, adapted to break the ground in advance of said shaver blades ; and a fluke also carried by said frame, for smoothing off the top of the row subsequent to the action of said off-barring elements.—BEET HARVESTER. *Charles W. Woodson*, of Los Angeles, Cal., U.S.A. *1,589,502*. June 22nd, 1926. A beet harvester comprises means for lifting beets from the ground, an inclined conveyor consisting of a pair of chains adapted to grasp the lifted beets and convey them upwardly and rearwardly, an evening device consisting of upper and lower pairs of conveyor chains, the upper pair of chains being arranged relatively close to each other to grasp the beet tops and draw them rearwardly, the lower set of chains being spaced from each other a greater distance than said upper chains and adapted to form guides to limit the upward movement of the beets, said upper and lower chains extending to points in proximity to said inclined conveyor, a pair of revolving cutting discs, arranged adjacent the rear end of said evening device to sever the beet tops, and means for collecting the separated beets and tops and delivering them to separate receptacles.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1926. Tons.		1925. Tons.
Total Receipts, January 1st to August 25th	2,353,192	..	2,425,853
Deliveries ,, ,, ...	2,176,833	..	2,349,371
Meltings by Refiners ,, ,, ...	2,177,000	..	2,272,580
Exports of Refined ,, ,, ...	63,000	..	199,000
Importers' Stocks, August 25th	185,015	..	76,482
Total Stocks, August 25th	236,126	..	165,280
	1925.		1924.
Total Consumption for twelve months	5,510,060	..	4,854,479

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924. Tons.		1925. Tons		1926 Tons.
Exports	2,909,728	..	3,440,894	..	2,756,843
Stocks	570,802	..	970,025	..	1,195,658
	3,480,530		4,410,919		3,952,501
Local Consumption	72,500	..	87,000	..	80,000
Receipts at Ports to July 31st	3,553,030		4,497,919		4,032,501

Havana, July 31st, 1926 J. GUMA.—L. MEJER

Sugar Crops of the World.

(Willett & Gray's Estimates to August 26th, 1926.)

	1925-26. Tons.		1924-25. Tons.		1923-24. Tons.
CANE.					
America	8,644,548	....	8,878,451	....	7,419,141
Asia	6,125,360	....	5,565,390	....	5,909,840
Australasia	612,344	....	536,490	....	345,757
Africa	679,042	....	545,260	....	572,022
Europe..................	9,000	....	8,087	....	7,871
Total Cane...... ...	16,070,294		15,533,678.		14,254,631
BEET.					
Europe..................	7,484,302	....	7,077,214	....	5,057,761
U.S.A..................	804,439	....	974,185	....	787,217
Canada..................	32,475	....	36,200	....	16,500
Total Beet	8,321,216		8,087,599		5,861,478
TOTAL CANE AND BEET..	24,391,510		23,621,277		20,116,109

United Kingdom Monthly Sugar Report.

Our last Report was dated the 9th August, 1926.

The market generally has been quiet in tone over the last month. No new feature has materialised. There is little pressure to sell on the part of the producers, and at the same time there is an entire absence of enterprise on the part of speculators who apparently have no wish to add to their comitments.

The terminal market was influenced by the continued liquidation of the August account, and altogether nearly 65,000 tons were tendered and this month was finally liquidated at 13s. 6¾d. Forward months were maintained at a considerable carrying premium. September fluctuated about 2¼d. over August and sold from 13s. 10½d. down to 13s. 5¼d. December at one time reached 14s. 7½d. but fell to 14s. 2¼d. March sold at 15s. to 14s. 9d., May at 15s. 4½d. to 15s. 0¾d., and August 15s. 8¼d. to 15s. 5¼d. The latest prices are September 13s. 8¼d., December 14s. 5¼d., March 14s. 10½d., May 15s. 2¼d., and August 15s. 6¾d.

Trading in actual sugars has been quiet but steady in price. There has been a scarcity of ready sugars f.o.b. Continental ports. Czecho Slovakia has practically disposed of this crop sugar, but business has been done in German Granulated from 14s. 7½d. to 14s. 10½d. f.o.b. Hamburg. The price of Granulated in London has been far below its true parity and considerable quantities of the London stock of Refined has been sold to the trade at prices varying between 26s. 10½d. and 27s. 1½d. duty paid. Even some of the outports have been drawing their sugar from London.

The refiners have bought about 5000 tons of out-of-condition sugar at about 6d. per cwt. off the sound value. There is little demand for forward but the value of Czecho Granulated for November/December is 14s. 10½d., and April/June 15s. 6d. f.o.b.

India has been in the market again and owing to the shortage of 300,000 tons in the Java crop several contracts have been made in European sugars, chiefly Polish and Belgian, at about 16s. 1½d. c.i.f., India.

The English crop is very satisfactory, and it is estimated that the production this year will be 130,000 tons.

The refiners have made little change in their prices. On the 13th August they reduced the Empire Grown sugar from 28s. 3d. to 28s. On September 9th all their prices were advanced by 3d. per cwt. The latest prices are No. 1 Cubes 33s. 6d., London Granulated 29s. 4½d., Empire Grown 28s. 3d.

The British refiners have not been in the market for raws to any large extent. Prices for raws have been relatively dear against the price obtainable for Refined. Business, however, has been done in Peru 96 per cent. from 11s. 7½d. to 12s. c.i.f., and Cuban 96 per cent. sold from 11s. 9d. to 12s. 1½d. c.i.f.

In New York there has been a good demand for Refined and the refiners have been continual buyers of raws. Porto Ricos and Philippines have been sold from 4.21 up to 4.33 c.i.f. New York, but these sugars are now coming to an end and Cuba is the only main source of supply. Large quantities of Cuban 96 per cent. have been sold from $2\frac{7}{16}$ths to $2\frac{9}{16}$ths which is the latest quotation.

The improvement reported in last month's report in the European Beet crop has been maintained, and over the last few weeks exceptionally fine weather has been experienced. The latest estimate of the crop is 3/400,000 tons less than last year.

With regard to the Cuban crop, the stocks at the ports are now only 100,000 tons more than last year, and the total stock in the island is 1,450,000 tons against 1,150,000 tons last year.

21, Mincing Lane,
London, E.C. 3.
9th September, 1926.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 334. OCTOBER, 1926. VOL. XXVIII.

Notes and Comments.

The Coming British Beet Campaign.

The coming beet sugar campaign in this country promises to start under favourable auspices. The weather the last two months has favoured the development of the roots, and at Cantley, for instance, there is every indication of a record season for sugar content; beets already tested there show an average sugar content of 16·01 per cent., while one consignment averaged 18·4 per cent. And up in Scotland, in the Fife district, what are said to be exceptionally fine crops are maturing.

Further attempts are being made to justify the erection of several factories in the south of England; the decision rests with the farmers, but indications suggest that these are now showing more disposition to undertake the necessary growing of beetroots. The Yeovil factory, in particular, seems now more likely; and in Wiltshire the Anglo-Dutch group are nursing the county with a view to getting support for a factory there, possibly at Warminster. A new factory is also projected for the Wellington district of Shropshire, and a company has been formed[1] to carry it out, subject to the promise of a minimum of 8000 acres by the beginning of December. This project would cost upwards of a quarter of a million, and if the necessary support is forthcoming, the plans are for the factory to be erected in time for the 1927 crop.

The Anglo-Scottish group would appear to be adopting an attitude of caution with regard to further factory projects. To judge from a letter that Lord WEIR, the head of the group, wrote last summer, his Corporation's contracts with the eastern counties farmers in 1925 were not in the end satisfactory to the company; he termed them in fact "a costly failure, redeemed only by their success in bringing in new growers." The deplorable weather conditions that ruled last November were of course responsible for upsetting the factory performances, but it is evident that the farmers on their part did not sufficiently realize their responsibilities. Lord WEIR advocates developing a system that will link the growers still closer to the factory, so that they and it become real partners. Instead of misunderstandings and suspicions as to contract prices, he would like to see contracts based on more modest guaranteed minimum rates, such rates being on a true economic basis, and then in addition a bonus on the financial results of the campaign.

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[1] Hygienic Sugars Ltd., Wellington. It is said that over 50 per cent. of the capital will be British and the rest supplied by Continental interests.

Trade Depression in Cuba.

Reports from several sources all indicate that the unremunerative price of sugar, Cuba's staple crop, has brought a severe trade depression to the island, and it is only the knowledge that Cuba possesses a wealth of natural resources to draw on in the long run that enables the economic forces to carry on and prepare for better days. The immediate outlook is more or less pessimistic. As an instance it is recorded that the period from April to July, usually the busiest season for dealers in agricultural and mill machinery and supplies, has been extremely dull, May having been for some important concerns in Havana the worst business month for the past ten years. A good many distributing houses are reported to be in financial difficulty and to have asked for suspension of payments. To add to the difficulties of Cuban trade, sugar has not been the only commodity to be unprofitable. The tobacco growers claim also that they cannot secure an adequate price for their crop this year; nor are pineapples yielding any more satisfaction. So altogether 1926 is proving a depressing year for Cuban trade generally. Efforts are being made to get rid of the visible supplies of sugar before the next crop comes into market, and Cuban sugar has been sold at abnormally low prices to such destinations as South America, South Africa, and the Far East, in each case coming into competition with established sources of supply. Opinion differs as to such comparatively unhealthy competition being beneficial to the markets concerned; but if Cuba can, by disposing somehow or other of her surplus sugar, enable her 1927 crop to secure a remunerative price, the psychological effect on the world's market may not be negligible.

Disposing of the Cuban Surplus.

Apropos of the attempt of Cuba to get rid of her surplus stocks of sugar, and its effect on the world market, the following remarks taken from a Market Report of Messrs. Lamborn and Co., of New York, are of some interest. "Some conservative authorities (they wrote) are now estimating that Cuba will ship, by the end of this year, almost 300,000 tons to the Far East—Japan, China and India. So far, it is estimated that Japanese interests have purchased fully 20,000 tons new crop Cubas, for February/March and March shipment. There is still buying interest in this market for both old and new crop sugars from that source. In addition, it is reported that India is showing continued buying interest in new crop Continental sugars. The heavy purchases by the Far East from Cuba during the past few months have somewhat changed the Cuban statistical position, as these purchases appeared to have been of sufficient volume to absorb a considerable amount of the surplus and thus materially lighten the burden of producing interests. It is also conservatively estimated that the total sales by Cuba to destinations other than the United States, are almost 1,000,000 tons, and it is believed that neither Europe nor the Far East have completed their purchases for this year. Of course, advancing prices will have a checking influence on further purchases by Europe from the old crop, but they are expected to have less influence on the volume of sugar to be purchased by the Far East, as such purchases are being made owing to absolute necessity as a result of the sold-up condition of Java."

Messrs. Lamborn also point out that in the United States the enormous fruit crops of this year will mean a record-breaking consumption of sugar, that will necessitate an important buying movement. In view of this, it is not surprising that the leading Cuban interests, who are in control of the unsold sugars on the island, are now intent on selling only on a rising price. Other sugars that ordinarily find their way to the U.S. market have been exhausted, and Cuba is the only important producing country having any sugar available for the balance of the year.

The Sena Sugar Estates.

An interesting account of the difficulties met with by the Sena Sugar Estates in Portuguese East Africa in combating the persistent Zambesi floods was given by the chairman, Mr. J. P. HORNUNG, at the annual meeting of the company held in London last month. The accounts presented referred to the year 1925 and there was a loss shown of £118,673. Since, however, last year a sum of £157,384 was carried forward to meet these foreseen losses, a balance on the right side of £38,710 is now shown, out of which the Preference dividend has been paid and £20,000 transferred to reserve.

Mr. HORNUNG (who has from reasons of health been absent from these annual meetings for several years) detailed the causes of this big loss. The crop for the year under review, instead of producing as anticipated an output of 50,000 tons of sugar, only yielded 22,692 tons. This was due to a disastrous flood which visited the Zambesi valley during the early part of 1925, and submerged so much cane for several months, that it was a wonder as much sugar was obtained as was actually done. In part this is attributed to the fact that the cane planted was entirely Uba, which showed wonderful resisting powers when sweeter softer canes would in all probability have died out completely.

The unpreparedness of the company for this flooding was due in the main to the fact that prior to 1918 such occurrences were almost unknown ; but since then they seem to have entered a flood cycle. The particular flood water came down the Shire river (a tributary of the Zambesi) from Lake Nyassa, owing to the latter overflowing. Evidence has accumulated to suggest that the rising of this lake occurs in cycles which have some connexion with sun spots, and it is expected that the lake will continue to rise for another year or two, in which event there will again be abnormal flooding conditions to deal with down the Zambesi.

After the 1925 flood the Sena Company realized their danger on this score, and started to protect their estates as far as possible by means of defence embankments. The country being nearly flat, this meant immense work, but with the labour available a hundred miles or more of embankments were thrown up. Before these had time to settle and consolidate, the Zambesi was again over its banks—this time in January last—and continued in this condition till the end of March. The defences however came fully up to expectations, and for some two months kept the water off the cultivated land, and held back 12 ft. of water. In the end, the pressure became too great in certain places, and the banks got breached with consequent flooding. Fortunately by then the wet season was nearly at an end and the damage done was negligible.

As showing how different were the conditions prior to 1918, Mr. Hornung pointed out that from 1886 to 1918, a period of 32 years, (most of which time he was out in the Zambesi district) no flood of importance occurred ; so it was not surprising if they drew the conclusion that floods were a very unlikely contingency to guard against. Now the need is realized, the protective embankments will be further improved and strengthened.

The present year's crop of sugar promises well, thanks in part to the working of the new Luabo factory. Everything points to an out-turn well in excess of 40,000 tons, most of which has already been manufactured. The misfortune that has dogged the estates for several years seems well in process of being overcome. Mr. Hornung in fact was confident that, given normal seasons and a consequent sufficiency of cane to keep their factories fully supplied, as well as a somewhat higher level of selling prices for their sugar, the results of future years would be satisfactory to everybody interested in these estates.

Sugar Legislation in South Africa.

According to telegrams published in the *Times* on the South African sugar industry, it would appear that the Union Government are proposing to carry out the recommendations of the Board of Trade enquiry recently held, as it relates to sugar prices, by fixing the maximum retail price of sugar at the coast at 3¾d. per lb. and imposing an extra import duty of 3s. 6d. per 100 lbs. But they do not intend, it seems, to put the new law in force till long standing matters at issue between the millers and the planters have been placed on a sound and satisfactory basis ; the latter disagree strongly as to the fairness of agreements made over 20 years ago and still enforced by some of the mills. However, the Governmental proposals to fix the wholesale and retail prices of sugar are meeting with strong opposition from the Chambers of Commerce, and it does not appear likely that an early agreement will be reached that would result in carrying out the reforms the new legislation has in mind.

A Disastrous Cane Fire in Natal.

It was only in our August issue that we published two papers on Canefield Fires, and now we have to record what is said to be the largest fire in the history of the Natal canefields. It broke out in the plantations of the Illovo Sugar Estates, Ltd., and tore along the coast with the rapidity of flame in a stubble field. Fortunately an off-shore wind kept it from penetrating inland across a dividing road, while the river at one end and a cane break at the other eventually terminated its path of destruction. But within those wide limits the destruction was complete. The heat of the fire was said to be such that fire-fighters were driven 200 yards away from the flames. The staff of the estate with the aid of hundreds of native boys turned out, but could do nothing to stay the advance of the fire ; and the flames spread so rapidly that some 20 natives were caught and burnt to death, while of three Europeans who were also caught, two saved themselves by lying down under a bank of earth with some wet sacks over them , the third appears to have escaped more miraculously, for only a sudden whirlwind which deviated the approaching flames and allowed him to slip aside saved him from cremation. When the fire finally died out, it left nothing but charred fields of canestalks, most of which will hardly have been worth milling, even if they could be got to the mills in time.

Notes and Comments.

Agricultural Progress in Jamaica during 1925.

The Annual Report of the Department of Agriculture in Jamaica for the year 1925 records a good season for the production of sugar and rum. The exports of sugar were approximately 38,000 tons, as compared with 23,000 tons in 1924. Rum showed an increase of about 3900 puncheons over the exports of the previous year. The trade in high-flavoured rum is returning and some Northside Estates producing rums with a high content of compound ethers realised record prices for their product. Unfortunately the enormous increase in the Cuban production tended to lower the price of sugar to such an extent that there was only a moderate margin for profit on the very good sugar crop that was produced in 1925. The greatest event of the year as regards sugar was the erection of the large central factory in St. Thomas by English capital. Remarkable results are stated to have been obtained in the rapid development of cane cultivation in this area.

The Superintendent of Agriculture records his satisfaction that the position of mosaic disease has been in the majority of cases maintained, in that the disease has not increased and is under control, and does not seriously affect the output of sugar. This, however, has only been done by vigorous and continual roguing and in some cases at considerable expense. A large estate, located in the centre of the Island, estimates that mosaic disease is costing them £1000 annually in the labour involved and in the loss of growing cane from roguing. It will thus be seen that on some estates the position is still very serious. Where roguing has not been found efficient in the control of the disease, due to its rapid and extensive spread, resort has been made to the Uba cane, which fortunately for several estates has been found to do well. In fact several of the estates of the Island would be out of commission were it not for this cane, as it was found impossible to control mosaic disease on these particular estates.

One interesting fact regarding mosaic has been brought out during the last two years, namely, that the "Fall Plants" are not attacked to the same extent as the "Spring Plants." This is also the case in Cuba, according to a recent publication. Thus by planting new fields only in the fall of the year the proportion of canes rogued out on account of mosaic infection during the first crop is considerably reduced. At the commencement of the year experiments were carried out with *Aphis maidis* as a vector of the disease. The results proved that this insect was capable of transmitting the disease from corn to cane and from cane to cane. At the same time it is admitted that sugar cane is not a natural host of this aphis, which prefers other plants such as corn and Guinea corn. There is, it appears, a great discrepancy between the laboratory results with insect vectors of this disease and field experience. In the laboratory it is very difficult to get this aphis to transmit the disease from plant to plant, yet in the field, under certain conditions not at present well understood, the disease spreads in a wholesale manner. Yet *A. maidis* is still the only insect in Jamaica definitely proved a carrier of this disease, though certain other insects have been reported from time to time, but on insufficient grounds. These have not yet been confirmed as carriers, and are only under suspicion at the moment.

Froghopper Pest of Sugar Cane in Trinidad.

At a general meeting of the Agricultural Society of Trinidad and Tobago held at the Imperial College of Tropical Agriculture on June 10th,[1] Dr. C. L. Withycombe addressed the members on the subject of the froghopper pest of sugar canes ; and gave an account of the pest and referred in general terms to many of the points dealt with in his paper published in the Annals of Applied Biology, which is summarized in another part of the journal.

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[1] See *Proc Agr. Socy. Trinidad and Tobago*, June, 1926.

It was pointed out that froghoppers antedated man as inhabitants of the island, and that it was the latter who, by cultivating large and contiguous areas under such crops as sugar cane, had upset the balance of nature and had led to the increase of the froghoppers.

The influence of the seasons and of insect enemies on the froghoppers was discussed, and the view was expressed that protection from froghopper attack was probably best assured by careful attention to cultivation and good agricultural methods, which tend to maintain the right water balance for the plant, and enable it to protect itself from attack, or at any rate to recover from it, more readily than where the water balance is unfavourable.

Reference was made to palliatives. and it was suggested that attention might profitably be directed towards securing useful ones, for which purpose further investigations are needed. As considerable difficulty is encountered in applying such materials as dusts or sprays to sugar canes, the speaker was of opinion that the use of aeroplanes is well worth consideration , and he exhibited lantern slides showing aeroplanes at work applying insecticides to such crops as cotton. He however suggested that work of this kind should be done by skilled persons who have had abundant experience, as otherwise the work would be ineffective and disappointing.

A Sugar Trade Review for Japan.

As we have had on more than one occasion to remark, information with regard to the Japanese sugar industry, including that of its dependency Formosa, is invariably scanty, and the assimilation of news is hampered from the fact that almost all that is published from Japanese sources is naturally in the Japanese language, of which few journalistic linguists can claim even a smattering of knowledge. The Board of Investigation for the Sugar Industry of Japan, a body instituted some ten years ago, has lately realized this isolation, and desiring to extend its usefulness beyond its territorial borders and encourage exchange of information with other countries, it has lately started a sugar trade review[1] in the English language, which for the time is to appear in alternate months. The first two numbers are to hand and give a good deal of statistics about the sugar industry in the East.

Japanese Sugar Production.

From them we glean the following data *re* the Japanese sugar industry. Sugar production in the Japanese Empire is divided into two parts, Home and Colonial, the latter term referring to Formosa only. The chief sources of the home product are Kagoshima, Okinawa, Daitoshima, and Hokkaido. Their combined output for 1926 is put at 1,966,000 piculs (of 133⅓ lbs.) or 117,024 long tons.

The Formosa crop on the other hand forms the largest part of the Japanese production and is increasing yearly ; the 1926 crop is now estimated at nearly 8½ million piculs (500,000 tons). Of this, 500,000 piculs are required for consumption in Formosa itself ; 140,000 piculs of inferior grades are sent abroad to various destinations ; and the remainder, 7,870,000 piculs, are destined for the Home market in Japan proper. Most of this is centrifuga sugar, but a million piculs of plantation whites are included.

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[1] The Nippon Togyo Chosa sho, published at No. 4, 1-chome, Kakigaracho, Nihonbashi-ku, Tokio. Subscription Yen 30 per annum.

But in addition to this Empire sugar, Japan is a considerable importer of raws mainly from Java. In 1925 the total importation of foreign sugars came to 6,323,078 piculs (376,330 tons) some 5,600,000 piculs being Java raws for the Japanese refineries, while Cuban raws were also bought in fairly large amount owing to their comparative cheapness, Of these large amounts, at least 2½ millions was destined after refining for re-exportation, to China Altogether in 1925, according to taxation returns, 11,690,520 piculs of sugar of all sorts was dealt with in Japan for consumption, or re-export. But the imports of raws have tended recently to exceed requirements, and the present year started for the industry with a carry-over of 205,000 tons. In spite of this, the year is destined to see a fair amount imported, not only from Java but also from Cuba, whose sugars are now being offered to Japan at exceptionally low rates. It is accordingly imperative for the Japanese producers and refiners to extend their export markets.

China is perhaps the chief market for Japan sugar, and the year 1925 was an advantageous one for this trade ; the rate of exchange was favourable, while the chief competitor, Hong Kong Refined, was suffering from a state of boycott. As a result 2,400,000 piculs of refined were marketed in China. This year, however, conditions are much changed ; the boycott is ended, the rate of exchange is no longer so favourable, and a tariff revision convention now at work is expected to put Japanese sugar at a disadvantage. The 1926 exports to China are consequently expected not to exceed 1,900,000 piculs (say 113,000 tons). On the other hand, the production and importation total for 1926 is expected to amount to 12,387,000 piculs, an increase over last year of nearly 700,000 piculs ; so unless exports are correspondingly increased, the Japanese industry is faced with the prospect of a large carry-over of stock at the end of the year.

A Brewing Sugar Amalgamation.

The brewing industry in this country which was in a rather depressed condition at the termination of the war has since then developed to a remarkable degree in spite of the more restricted hours of opening permitted to houses where drink is publicly sold. Naturally the manufacture of brewing sugar has correspondingly prospered. There are very few firms concerned in this trade and two of the biggest of them have recently been combined, Mambré Sugar & Malt Ltd. having acquired the business of its principal competitor, Garton Sons & Co. Ltd. To finance the transaction an issue was recently made of new ordinary, deferred, and preference shares, which were largely over-subscribed for. The former capital of the Mambré Co. was £750,000 and the new issue will raise it to £1,800,000 nominal, but on the basis of market values this will be worth something like £5,000,000. This company has in recent years paid 17½ per cent. regularly on its ordinary shares and approximately 90 per cent. on its deferred shares. But as the existing shareholders of both companies have the first refusal of subscribing for a share of the new issue proportionate to their existing holdings, it may be assumed that the outside public obtained very little of what looks a decidedly attractive investment of its kind.

In a recent speech at Port-of-Spain, Trinidad, Sir Francis Watts, President of the Agricultural Society, remarked that the production of sugar is of great importance to Trinidad, this industry being second in importance only to that of cocoa; indeed, in recent years the value of the exports of sugar have very closely approximated to those of cocoa, for while during the past four years the value of the cocoa exported has averaged £1,223,965, that of sugar has been £1,155,287.

Fifty Years Ago.

From the "Sugar Cane," October, 1876.

This number of our predecessor was mainly given over to discussions of the international sugar question, the proposal made by Holland to enforce sugar refining in bond internationally being the issue before the Conference. There was little this month in the nature of technical matter.

An article appeared on "The Sugar Industry in Lousiana" which had just produced the largest crop in her history since the year 1870-71, namely about 83,800 tons, which was about 40 per cent. of the total consumption of the U.S.A. of that day. But outside competition was keenly felt, and planters were here urged to adopt improved methods of cultivation and manufacture in order to meet this, and if possible to increase the quota of this State. "It has long been a reproach to many of our sugar planters that they have been slow to follow the example ot those who have had the intelligence and enterprise to experiment in improvements, some of which have proved fruitless, while others are of permanent value. . . . . The expense of introducing improvements, even when their value is fully established, is undoubtedly the great obstacle to their general adoption. This evil necessarily arises from the large investments already made in engines and machinery, which have absorbed the capital of the planter and left him without the resources to substitute for them new and costly innovations. And yet it is only by such means that we can expect to maintain sugar making in Lousiana as a leading branch of industry. The evil involved in the Hawaiian treaty inculcates that we should spare no effort to reduce the cost of cultivating cane and of manufacturing sugar, so as to enable us to compete with the foreign product, even if it were admitted free . . . . . In examining this subject, it is manifest that those who maintained their position would be enabled to do so, not only by using more productive methods, but by the use of larger capitals, which would prevent the introduction of the same on small plantations. The conclusion to be drawn from this fact is that we should cordially encourage the investment of large capitals, whether by individual proprietors or by jointstock companies, not so much for cultivating cane, as for making sugar; for the same reason small farmers and planters should be encouraged to cultivate with the view to selling their raw product tô the nearest manufacturer . . . . . When sugar making is carried on in this spirit, Lousiana will exhibit a degree of prosperity unprecedented in her varied and eventful annals, and the exchangeable value of her produce will be greater than that of any mining, any cereal, or any cotton state in the Union . . . . ."

George C. Stewart, Chief Chemist at the Cappielow Sugar Refinery, Greenock, published some "Notes on the Analysis of Animal Charcoal," in which he dealt with the determination of sulphur and iron. Briefly his method was first to ascertain the total sulphur by digesting 10 grms. with nitric acid and potassium chlorate, evaporating nearly to dryness, diluting, and precipitating with barium chloride; following this, he found the sulphate-sulphur by digesting 10 grms. with dilute hydrochloric acid, and precipitating with barium chloride; lastly he determined the iron volumetrically by the permanganate process. Then the total sulphur was calculated to calcium sulphate, and that left over to ferrous sulphide, while the iron unused in this combination was assumed to be metallic.

It is of some interest to note the consumption of sugar in Europe fifty years ago, this being for Great Britain, 911,000; France, 270,000; Holland, 26,000; Germany, 316,000 and six other *entrepôts*, 115,000 tons, for the year 1876.

The Natal Sugar Congress.

The Natal Sugar Congress goes from strength to strength and appears to be likely to continue so to do ; for its members do not seem, by any means, to consider that it has reached perfection. Criticisms of an eminently friendly nature were indulged in at its conclusion, both of one another and on the best way in which to make it a greater success. The main subject of complaint appears to have been in the numbers who were able or willing to leave their plantations or factories to attend the Sugar Week in Durban ; and various suggestions were offered as to the best way to increase the size of the meeting. Some speakers, commenting on the proceedings, appear to have felt that the mental strain had been rather severe and advocated a little more variety in the shape of excursions and relaxation in various directions. On the other hand, this very criticism reflects the value of the work done and the seriousness with which the problems had been approached. To suggest an analogy, if one ate freely of every course on the long drawn out menu of a bountiful dinner, it would not be surprising if a feeling of satiety were the immediate result, possibly followed by some trouble with the digestion. But our analogy does not hold in one important particular ; for, with the admirable record so quickly got together, printed and circulated, there is no danger of any item in the menu, once passed, being lost for ever.

The dangers in diluting the succession of papers by relaxations, of the nature of "joy rides," is obvious. As the Secretary, on whose shoulders were borne almost all the heavy work of organizing the meeting, pointed out, the Congress is dominated by the time limit ; none of the papers or discussions could with advantage have been omitted, and to spread out the time occupied from a week to a fortnight would, more likely than not, tend towards a diminution of the small attendance which is deplored. The suggested selection of delegates by each section of the industry or of the country to represent them appears to be more worthy of consideration ; and doubtless the Secretary will bear in mind this and other useful remarks which were made. For the rest, it would appear that two or at most three main subjects would suffice for each day's work ; and it might be possible to arrange for each day some field work, either on the experiment station or some neighbouring estate. No time table is given of the meetings, but it is presumed that the evenings are free for social and other diversions. As for the idea expressed by some that, in time, all of the important subjects will be worked over, and there will thus be less need for set papers in the future, this does not seem to be very likely, considering the rapidity with which the industry is approaching a crisis in its history ; not to mention the increasing output of work by the various experts and others engaged in experimental work. In these circumstances, the annual interval at which the Congress is held is by no means too long ; and there is every indication that for many years to come there will be an abundance of material for study and discussion. The only question likely to arise is whether the heavily taxed officers will be able to devote the time properly to prepare their papers for the Congress.

More time than usual appears to have been devoted to factory matters, and the greater part of the first two days were taken up with the reading of papers on Electrification of sugar factories, Bagasse furnaces, The use of bagasse as a raw material for manufactured goods, Standardization of chemical control, and the Drying out of sugars at different altitudes. Further papers were read on Changes taking place in the soil, The plough and the principles underlying its use, Growing food for stock on the sugar farm, Handling of cane from field to crusher, Improvement of cane by selection, The cane disease situation, Cane varieties suitable for Natal; while discussions were held on the advantages of co-operative buying and trucks for transport. The experiments conducted at Umbogintwini, preliminary results of green manuring, and a visit to the Association's Experiment Station at Mount Edgcumbe were also included. It is not the purpose of the present article to go at all deeply into this very various and important list, but something must be said on the subject of cane diseases, as matters here appear to be approaching a somewhat serious crisis.

Perhaps the most illuminating paper presented to the Congress as to the present conditions ruling in the sugar industry, was that read by the Government mycologist, H. A. STOREY, concerning the stage reached in the campaign for eradicating mosaic and streak diseases from the fields. It is noteworthy that, during the past year or two, the question of mosaic has not been very much to the fore in the Congress discussions; the mycologist has been content to stand by, and the natural conclusion may have been drawn, by outside readers, that the various difficulties connected with eradication and control were being overcome, and the best way of effecting this was being worked out and put into practice. But, putting it crudely, nothing is apparently being done with regard to mosaic. The experience gained in Louisiana of the results of such delay was very forcibly put by various members in the discussion which followed the paper, and this very much to the point; and BRANDES is quoted as writing "It has generally been our experience that no action has been taken against mosaic until control has become impossible." But, reading between the lines, there is obviously a lack of agreement among the members of the Association, if not as to the necessity and urgency of the matter, about the payment of compensation for clearing out the canes at present harbouring or capable of harbouring the disease. This augurs ill for the team work, which will be the first thing needed for successful results in the new experimental campaign.

It is clearly shown in the paper that the presence of mosaic, although not directly endangering the Uba cane, has a wide influence on the future of the industry. In the first place, it is obvious that, if the matter is not dealt with summarily, the present favourable position is likely to become more difficult year by year, and eradication may indeed rapidly become impossible; and in the second, the introduction of a second string to take the place of Uba, if that be necessary, is endangered and the whole of the excellent quarantine work recently inaugurated is likely to be put out of action. The whole campaign against streak is also involved. Speakers with an inside knowledge of conditions in Louisiana pointed out that the crops had decreased, from 18 tons of cane per acre to 6 or 7, within recent years; and in large part at any rate this was put down to the increase in mosaic. The case in Natal differs, it is true, in that Uba cane is immune to mosaic; but the whole question of providing a second string for the industry is involved. Experiments have already indicated a couple of excellent substitutes for Uba, namely D 1135 and Badila. The former is spoken of as follows: "It will grow on any good soil under normal rainfall conditions; grows more rapidly than Uba, is easily trashed and of a high recoverable sucrose." Badila is said to be "one of the richest canes known, will grow well in Natal under irrigation, and in all probability on alluvial lands and in well watered hollows," pointing especially to its replacing Uba in the Zululand flats. But both of these are ruled out, if mosaic is allowed to remain in the country; for their susceptibility to this disease is high, the proportions of loss reaching 36 per cent. and 78 per cent. respectively.

A somewhat similar disadvantage is attached to the introduction of the otherwise promising Java crosses, known locally as Argentine canes; for while these are not themselves very much injured by mosaic, they very readily become infected, and then will act as carriers to any susceptible cane with which they come into contact. The careful work now being carried out at the newly-installed quarantine station will obviously be more than neutralized if a determined attempt is not made to stamp out this disease. It must be not a little galling to the writer of the paper, when he has to state that now for four years he has stood up and pointed out the only sound way for Natal to act with regard to mosaic, and yet nothing has been done to cope with it, in the manner advocated by all experts whose advice has been sought on the subject, and blessed by the Sugar Association.

STOREY gives details of a very telling example of the success which can be obtained by digging out all susceptible cane varieties from the fields. In February, 1923, a number of varieties of thick tropical canes, which were considered to be suitable for South African conditions, were introduced by the Natal Estates Ltd., and these canes were placed under his charge, and have been constantly inspected by STOREY and his staff. During 1923, the plots were grown on less than half an acre, and at first the canes were entirely healthy; but in a few months evidences of secondary infection began to appear. All diseased stools were immediately dug out, yet each month 10 to 15 new cases appeared. Then the management agreed to root out all existing mosaic-susceptible canes from the fields, as these were naturally regarded as the source of the recurring secondary infection. At the time of writing, no more such canes were known to exist in the 20,000 acres of land controlled by the Company. Meanwhile, the introduced varieties had gradually extended until they covered about six acres, closely planted. "The number of diseased canes in these plots in the last year has been extremely small, and in the last two months it amounted to two possible suspected doubtful cases of mosaic . . . Where three years ago secondary spread of mosaic threatened to wipe out the half acre, it is now possible to grow six acres and to keep it absolutely free from the disease with the minimum of trouble." The proposals suggested four years ago simply amount to this: but not only are the instances of such action rare enough among the planters as to be quoted as examples, but it is quite certain that, even if the planters do thus combine, nothing short of compulsion will induce the Indian growers to adopt the plan in their small patches on canes grown for eating.

The allied problem of the elimination of streak in the Uba cane is a more difficult one, as in some parts—"most of Zululand and the south coasts"—it may be said to have reached the "impossible" stage. But STOREY takes a more hopeful view, in that the planters appear to show more unanimity in their opinion as to its importance. In lightly affected areas, mainly in Victoria county, roguing has been successfully employed. Thus, the Natal Estates have been practising it for the past three years, and now claim that streak in their fields has been mastered; nowhere are more than 5 per cent. of the canes attacked, and in the majority of the fields only 2 per cent. of streaked canes can be found. The planting of healthy sets has also been abundantly justified. The first series of experiments at Umbogintwini has now been concluded and the results published. It will be recalled that, here, comparative plots were laid down with sets from healthy and streaked clumps; but the unsuspected presence of the insect vector caused rapid secondary infection in the, at first healthy, plants in the plot from healthy seed. Nevertheless, from the resulting crops, it is seen that this secondary infection was not sufficiently serious to wholly neutralize the advantage of the healthy seed; in fact this advantage was at least 12 per cent. in canes reaped. Obtaining sets from Uba, guaranteed streak free, is at present rather a costly business; but if the practice spreads it will probably become less so, and it is a simple matter for the planter to decide whether, in view of at least a 12 per cent. gain in the first year, it will pay. Where secondary infection is less rapid, the gain should be greater, but it cannot be expected to continue in the ratoon crops, if the infection is complete, as in the experiments referred to.

A better method of procedure is to make use of some streak-free substitute for temporarily replacing Uba in severe cases where eradication is considered impossible otherwise. Such a cane seems to be already available in D 1135, which at present appears to be immune from this disease. But this cane cannot be used as long as mosaic is present in the fields; and so the fight against streak is mixed up with that against mosaic. This should be an additional reason for the industry to get together and seriously to set about the regeneration of its cane fields.

C.A.B.

Some New Facts concerning the Flowering of the Sugar Cane.[1]

This paper presents certain aspects of the effect of flowering of the sugar cane which are of special interest where, as in Louisiana and other places outside the tropics, the growing season is short in each year. In North India, whatever may be the reason, the arrowing of the cane is looked upon with disfavour. It is rare in this tract, and the cultivator, always a keen student of nature, is disturbed by anything out of the ordinary, with a tendency to regard it as a portent of some evil. An extreme case is given by WATTS, where whole villages have been known to move to another locality because of the flowering of their canes. But recent work has shown that this feature of the sugar cane is not wholly evil, although in certain tracts it may signify a lack of moisture and possibly an impending drought—a disaster always hanging over the cultivator in India.

It is usually considered, nowadays, that the main case against flowering is that it obviously stops the further growth of the cane. If this growth is not renewed, all is well; but when, through favourable conditions of moisture, the buds at the top of the flowered cane shoot, sugar is used up and the glucose ratio increases to the detriment of the juice. The rational way of regarding arrowing would be that it is a sign that the shoot has reached maturity, and that it is therefore more characteristic of early maturing canes, although this is not always the case. No increase in weight of crop will take place after flowering; and if conditions are in favour of a resting stage—which frequently happens in North India at this time of year, because of diminishing heat and evaporation—there should be no appreciable deterioration in the quality of the juice.

Observations were made by the author in Bihar on the Saretha cane, a kind which flowers more freely than other North Indian kinds, and his results confirm those obtained elsewhere. The canes were planted in January, 1924, and flowered in November, but all of the canes appear to have entered on this stage in succession until the end of February, when he states that the whole of the canes were in flower. Flowering and non-flowered canes were cut at intervals during this period, and tested in various ways. Lots of fifty canes each, weighed during January and February, showed that there was no decrease in weight after flowering, and the canes on the whole were heavier than those not in flower. Analyses of percentages of juice and sugar on cane made during December to February, also showed that there was little if any decrease in the quantity of juice or sugar. There was a steady increase in sucrose in the flowering canes, and this was always higher than in the non-flowered canes cut at the same time. It was only at the very end of February that the quotient of purity showed signs of decreasing.

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[1] Flowering of Sugar Cane. M. GHOSH. *Agricultural Journal of India*, XXI, I. January, 1926.

It is well known that almost any factor which arrests growth in the sugar cane tends to an increase in the richness of the juice, and GHOSH gives two instances of this. The Khari cane, after a prolonged period of drought, gave juice containing about 19 per cent. of sugar, whereas the same cane when conditions for growth are favourable gives only 16 per cent. Again Rhcora, a notably late cane normally ripening in the beginning of March, under waterlogged conditions ripened in early December, yielding a juice of remarkable purity almost entirely free from glucose. The author also noted that the first cane arrowing in a clump is usually the best developed. These facts are of considerable importance in the testing of seedlings as to the richness of their juice. In any batch of seedlings with a common origin it is always the poorest grown, stunted forms which give the richest juice. Again, there is a remarkable difference in the quality of the juice in the different canes of a seedling, the mother or main shoot being far ahead of the others in development, and the rest following in the order of their date of origin. As the result of these difficulties it is always better to defer forming an opinion of the richness of the juice till the second year, when the seedlings are reproduced from cuttings; here the canes ripen much more uniformly, and any casual arrest of growth which may have caused stunting in the seedling is ruled out.

Another point of interest noted by the author was the effect of climatic changes, which are especially noticeable in sub-tropical countries as winter approaches, upon the composition of the cane juice. The sudden setting in of a cold spell, for instance, checks the ripening process, and the sucrose content in canes still growing is lowered. But, in canes which had flowered, such a change was not perceptible; these canes, having presumably entered the resting period, were much more resistant to the effect of such climatic changes. And this fact should be borne in mind by the cultivator, as more than counteracting any loss in weight by the cessation of growth on flowering. It also enables him to prolong his reaping season, and to cut the canes at his leisure. There is, of course, no frost in Bihar, although this is liable to occur at the other end of the North Indian sugar tract, far to the north west. A frost would necessitate the reaping of flowered canes, but would kill the growing canes outright.

C. A. B.

It is announced that Dr. ARTHUR H. ROSENFELD, who has been in past years a contributor to our pages on Argentine sugar matters, and more recently has been special technologist at the Insular Experiment Station, Porto Rico, has been engaged by the American Sugar Cane League to go to Louisiana and take charge of a scheme for rehabilitating the sugar industry in that state. The engagement is said to be for five years.

Malaria and Irrigation.

It is a common experience in India that, when new tracts of desert are opened up by irrigation, sooner or later malaria appears—in a tract where it was never known to exist before. But it is the object of this article to suggest that there is no necessity for this, if proper care is taken not to waste the water, by watering portions of the land on which no crops are being grown. Malaria is, in all probability, the most widely spread and the most serious economic disease in the tropics : it affects all classes of the community and, besides the recurring severe cases often ending in death, lowers the vitality of a vast number of workers, whether employers or employed. It is not generally appreciated that what may be called "tidy irrigation" has a very close connexion with the problem, in dry sugar cane regions.

Everybody knows, by now, the main facts concerning malaria, for in no disease has such a flood of illuminating literature been let loose during the past quarter of a century. But the knowledge of most people is confined to the more violent symptoms, when the labour is incapacitated for work in the fields, and the employer is forced to go away for a change of climate. Such knowledge of malaria is superficial, and it is worth emphasizing the fact that there are comparatively few who are aware of its steady sapping of the vitality of the people in the tropics. Although it may be true that no tropical disease is so well-known, it is one of those cases where the more we know the more there is still to be learnt. There appear to be very many distinct types of the disease, beyond the ordinary tertian and quartan as well as the more complicated diurnal or irregular, the benign and malignant, and the various combinations and permutations of these; and much has still to be worked out. What, for instance, was the cause of the writer's experience in India, when, after a serious attack of "malaria" and apparent recovery, it reappeared later and almost punctually with the first day of each month for a period of half a year, and then culminated in an attack of brain fever in a nursing home followed by a prolonged leave of absence ? The personal element has always to be considered, and this is rarely possible in malaria. Even the time honoured remedy of taking quinine has been recently called in question, although the greatest differences of opinion have long been known to exist as to the quantities considered necessary for protection. As the result of the experience gained in the late war many, indeed, regard the taking of quinine as of very little use, and yet no sane person will be without it on entering a malarial zone in the tropics. Locality should, then, be considered, as well as the personal equation.

But, in spite of these differences of opinion and the gaps in our knowledge which they reveal, there can be no doubt as to the life history of the organism causing the disease, since it has been repeatedly traced through all its stages, both in the human blood and in the stomach and saliva of the appropriate mosquito of the Anopheles clan. Summing up, a stage of sexual reproduction is gone through by the disease organism in the stomach of the mosquito, and the resulting individuals accumulate in the salivary glands, while asexual multiplication takes place in the human blood. The female mosquito acts as carrier and sucks the blood of a malarial patient, at the same time inoculating him with fresh virus from its saliva ; and any other individual which it attacks is similarly inoculated with the disease. The mosquito thus not only acts as carrier of the disease, but reinvigorates the organism causing it, by affording it the opportunity of sexual reproduction, which cannot apparently take place in human blood. Broadly speaking, with our present knowledge, the spread of malaria is impossible without the mosquito, and our real aim must be to prevent its biting us. We can do this by protecting our bodies, whether by living in gauze cages (especially at night for the mosquito is a nocturnal animal), or by covering the exposed portions of our skins, or again by smearing them with various substances known to be disliked by the mosquito, and so on ; but, needless to say, these methods are inapplicable to the native. The better method is to exterminate the mosquito from the neighbourhood ; and a good deal of very useful work has been done in this direction. The distribution and life history of Anopheles have been very thoroughly studied, for it can be easily distinguished from other mosquitoes. Water is necessary for its early stages ; but it is a curious everyday observation that, where the country in a monsoon region is covered by great sheets of water, malaria is not usually to be feared : if it were not so, one might well be forced to give up the job. The mosquito does not care for large sheets of water, and especially if the water is moving, as it generally is in rice cultivation ; therefore there is little danger from irrigation of itself. It prefers stagnant water, lined with vegetative growth, and can lay its eggs in any tiny puddle, no matter how small : for instance, the hoof marks of cattle in moist soil are a favourite location, and it has even been proved that the damp earth under a flower pot in the verandah will suffice. The wise European will make it a habit of inspecting his compound after rain, fill up the little holes where the water settles and kick away old tins or coconut shells, and pay special attention to leaking pipes, and so on. The mosquito appears to have a special liking for houses, probably because of its nocturnal habits, as they provide suitable dark places for it to rest in during the day. The late Professor Lefroy, who made a careful study of the habits of the mosquito, utilized this habit for the invention of an ingenious trap by which many mosquitoes can be captured each day. A large box was left open in some convenient place in the morning, when crowds of mosquitoes were seen entering the house : many sought repose in this box, which later was closed and a few drops of benzene put inside. The dead mosquitoes were then emptied and the box left open all night to get rid of the fumes, and thus be made ready for the next day's campaign. The box was blackened inside.

One of the most notable effects of malaria is the enlargement of the spleen, and the easy external observation of this organ is the usual means adopted in gauging the extent of the, often unsuspected, amount of infection of a native population. W. S. Earle,[1] a doctor on the Rockefeller foundation, has made such a study of 5000 children in the neighbourhood of Ponce, a town in the sugar cane tract on the south of Porto Rico, where irrigation is possible, and he has drawn remarkable deductions as to the connexion of malaria with sugar cane cultivation in that tract. He writes "In the hills back of the city 9·5 per cent. of the children were found with enlarged spleens : on the border of the city towards the cane fields, 17·4 per cent. were thus found : in the suburban zone, including the groups of houses just outside the city, a rate of 29·2 per cent. was found, while in the colonies in the centre of the irrigated fields the rate was 47 per cent."

With these facts before him, he made a careful study of the irrigation channels and their mosquito fauna, and found that this was concentrated in spaces where there was stagnant water lying, water which was rather injurious than helpful to the growth of the sugar canes, often very little, yet crowded with colonies of Anopheles. Leaky channels and the seepage from them causing damp spots along their route, carelessness in completely shutting off the water after irrigating the fields, and so forth, had left a series of wet patches which remained undisturbed between the turns of watering. On the other hand the irrigation channels themselves, if kept moderately clean, and especially the irrigated land, showed no such accumulations, and were quite free from mosquito larvae. He made an exhaustive study of the irrigation practices and, with the aid of a diagram, shows where slightly different treatment of the bunds made to regulate the water would obviate most of these irregularities ; but these details need not be repeated here, as of course the practices are mainly local and would be somewhat different in every country. The main line to be observed in irrigating the fields is just the same as that observed by every intelligent householder : to see that no water is wasted and left lying about to stagnate. " Tidiness " in field irrigation is as important as in the European compound, and should be an even easier piece of work. C.A.B.

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[1] The Relation of Irrigation in Canefields to the Malaria Problem. Walter S. Earle, International Health Board, Rockefeller Foundation. Porto Rico Experiment Station, Mayaguez. Note 21. November, 1925.

Hydrogen-ion Concentration Papers as used in Cane Factories in Northern India.

By Dr. JOHN HALDANE,
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The determination of H-ion concentration has now become a routine process in well conducted factories, and there have appeared numerous papers on this subject during the past few years. But the majority, if not all, of these articles deal with defecation and sulphitation control to the exclusion of carbonation. The following note mainly refers to the latter process, with special reference to the somewhat peculiar conditions prevailing in Northern India.

During the operating season 1924/25, attempts were made to introduce the " spot plate " method of H-ion determination, described by Brewster & Raines,[1] but owing to the necessity of employing somewhat illiterate " mates " as station foremen, this scheme did not meet with success. Resource was therefore had to the use of papers and with these a systematic control was easily obtained. The routine followed was as below :—

Preparation of H-ion Concentration Papers.

0.2 grm. of the indicator was dissolved in 50 c.c. of absolute alcohol and the resulting solution diluted to 350 c.c. with freshly distilled water. Narrow strips of filter-paper were then impregnated with this solution and dried in an acid-free atmosphere.

Application to Sulphitation Factories.

The liming and sulphuring stations were controlled by the following two H-ion concentration papers :—

	Colour Change	*pH* Range.	Application
Thymol blue	.. Yellow to blue	.. 8—9.6	.. Liming of raw juice
Brom-thymol blue	.. Yellow to blue	.. 6—7.6	.. Sulphuring of limed juice

It will be seen that the raw juice is limed to a *pH* 8·6 and then sulphured to *pH* 6·4. The method of procedure and control with these papers was as follows :—

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[1] *I.S.J.*, 1923, 25, 88.

The raw juice was limed until a faint blue colour was obtained on thymol blue paper which according to the *pH* colour chart indicates a *pH* value of 8·6. The limed juice was then sulphured, the course of the reaction being followed with brom-thymol blue paper. Initially, a brilliant blue colour is produced on the brom-thymol blue paper, but as the reaction proceeds the blue colour is replaced by green and finally yellow, should the sulphuring be continued long enough. In the sulphitation factories in Northern India, to which the writer is Chief Chemist, the reaction was stopped immediately a light green colour appeared on the brom-thymol blue paper, corresponding to a *pH* value of 6·4. In the following table are shown some results obtained.

Table I.

Raw Juice.	Limed Juice.	SO_2 Juice.	Clar. Juice.	Syrup.
5.2	8.6	6.4	6.2	6.2
4.8	8.8	6.4	6.2	6.2

APPLICATION TO CARBONATION FACTORIES.

The following H-ion concentration papers were found to be the most suitable for the control of carbonation factories working the De Haan process.

	Colour Change.	*pH* Range.	Application.
Thymolphthalein	Colourless to blue	9.3—10.5	1st carbonation
Cresol red	Yellow to red	7.2— 8.8	2nd ,,
Phenol red	Yellow to red	6.8— 8.4	2nd carbonation, sulphuring of thin juice
Brom-thymol blue	Yellow to blue	6.0— 7.6	Sulphuring of thin juice and syrup

In the De Haan process, the simultaneous liming and gassing of the raw juice was so controlled that a distinct blue colour was obtained on thymolphthalein paper, the end of the reaction after the requisite amount of lime had been added, being denoted by a faint blue colour. In the carbonation factories working under this control in Northern India, the alkaline juice from the 1st presses was again gassed until the bright red colour primarily shown by cresol red paper just disappeared, corresponding to a *pH* value of 7·8. Phenol red and brom-thymol blue paper were used in the control of sulphitation of thin-juice and syrup respectively. The *pH* value of the syrup was never allowed to fall below 6·4.

Table II gives some *pH* values of the products in four carbonation factories working under this control with the previously mentioned indicator papers.

Table II.

Raw Juice.	2nd Carb. Juice.	Clar. Juice.	SO_2 Juice.	Syrup.	SO_2 Syrup.
5.0	7.4	7.2	7.0	7.0	6.6
5.4	7.8	7.6		7.6	7.2
5.2	8.0	7.8	7.6	7.6	7.2
4.6	7.8	7.6	7.4	7.4	7.0

The low *pH* values of the raw juice compared with those of Natal, etc., as stated by R. G. W. FARNELL,[2] may be accounted for by the fact that the major portion of the cane supplies to these factories is brought in by rail, 48 hours or more having elapsed from the time the cane was cut to the time of crushing.

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[2] *I.S.J.*, 1926, 142.

A Contrast between Sugar Mill Plants in Cuba, Hawaii, the Philippines and Java.

By J. B. CASSELS
(of Pott, Cassels & Williamson, Motherwell, Scotland).

I recently returned from a visit to Java, the Philippine Islands and Hawaii, and having previously visited Cuba on several occasions I am struck by the differences in the sugar mill plant in these countries. Each country is doing good work, but using somewhat different plant to obtain their results. It is difficult then to make a fair comparison between these different countries, as conditions vary so much. There is the difference in climate to be considered, in cost of labour, in field conditions, methods of cultivating the cane,whether extraction or tonnage per hour is being aimed at in the mill, the duration of the grinding season etc., etc., these all making a really fair comparison very difficult.

In Hawaii, as we know, extraction is the thing most sought after in the mills, and the world's records for extraction are all held by Hawaiian mills, in addition to those for tonnage of cane and sugar to the acre. An average extraction for 40 factories in 1924-25 was 97·33 per cent. and nine factories showed figures over 98 per cent., though even this figure is not the record. The Philippine average figure was 94·04 per cent.; the Java figure about 94 per cent.; and the Cuba one about 94 per cent.

Cuba specializes in large sizes of tandems, usually with double crushers, and holds the world's records for grinding rates. The single crusher and 21-roller tandem at Central Vertientes has actually ground over 5600 tons per 24 hours. These figures do not point to the double crusher being necessary, though it has to be noted that there is in the tandem one extra mill to the usual equipment of double crusher and 18-roller tandem. Capacity is the *sine qua non* in Cuba, and not extraction, as the production of cane has increased very rapidly in recent years, giving larger amounts to be dealt with in a given time.

The Searby shredder has not yet become popular in Cuba and I saw only one in Java, Hawaii being the real home of this useful aid in grinding.

Cuba alone, up till now, has gone in for tandems completely electrified, and there are to-day none so driven in Hawaii, Java, or the Philippines, though one understands that the two new factories which the H.V.A. are laying down in Java for 1927 are to have the tandems driven by individual electric motors. No doubt their performance will be very closely scrutinized by the officials of the Java "Proef Station," as well as by others. The Petree & Dorr complete process is being used largely in Cuba, and in a lesser degree in Hawaii and the Philippines, but not in Java. "Meinicke" shoots are being used in all countries and the "Ewart" carrier in all but Java.

A comparison between the milling plants is interesting.

Cuba.—The average equipment is :—

Double Crusher of the Fulton type and 18-roller tandem, 36 in. × 84 in.
Many three and two-tandem houses.
Many completely electrified.
Where steam-driven, invariably Corliss valve engine, one engine often driving three mills in the tandem.

Hawaii.—The average equipment is :—

One set of cane knives, or levellers at the bottom of the cane carrier.
One ditto, at the top of the carrier.
One single-crusher Fulton, or Krajewski type.
One Searby shredder between the crusher and No. 1 mill.
12-roller tandem, 34 in. × 78 in.
No three-tandem houses, but many with two tandems.
All steam-driven by Corliss engines, usually two mills to each engine.

Philippine Islands.—The average equipment is :—

One single-crusher, Fulton or Krajewski type.
Nine or 12-roller tandem 34 in. × 78 in.
Some 15-roller tandems, 34 in. × 78 in., with no crusher, but the rolls on the No. 1 mill with crusher grooving.
One 3-tandem house.
Many with two tandems.
All steam driven by Corliss engines, usually two mills to each engine.

Java.—There are so many different sizes of tandems in Java, that I give the sizes of the actual ones I saw in 115 factories

76	..	30 in. × 60 in.
1	..	32 in. × 70 in.
28	..	32 in. × 72 in.
1	..	34 in. × 72 in.
10	..	34 in. × 78 in.
4	..	36 in. × 84 in.

The 30 in. × 60 in. tandems are mostly single crusher (Krajewski) and 9 or 12 rolls.
The 32 in. × 72 in. and 34 in. × 78 in. tandems are all single crusher and 12 rolls.
The 36 in. × 84 in. tandems are all single crusher (Krajewski) and 12 rolls.
There are eleven 2-tandem houses in Java, and none with 3 tandems.
All steam driven, by drop valve engine, often one engine to each mill, and never more than two mills driven by one engine.
I saw one Corliss engine driving three 36 in. × 84 in. mills, but this was an exception.

The Java extraction figures are interesting.

The average of 16—9-roller tandems gave an extraction	of	92·1
,, ,, ,, 21—crusher and 9-roller ,, ,, ,,	,,	93·4
,, ,, ,, 35—12-roller tandems ,, ,, ,,	,,	93·9
,, ,, ,, 81—crusher and 12-roller tandems ,,	,,	94·7
One 15-roller tandem (30 in. × 60 in.) ,, ,, ,,	,,	96·0
One crusher and 15-roller tandem (30 in. × 60 in.) ,,	,,	97·7

which table clearly shows that the best extraction figure is being obtained by the crusher and 15-roller tandem, incidentally the only one in Java.

The polarization of bagasse or " ampas " as it is called in Java was 1·7 per cent. on this crusher and 15-roller tandem, while the figure for the 15-roller tandem with no crusher was 2·5 per cent. I think that gradually Java will increase the number of mills in the tandem.

Java's field work is second only to Hawaii, irrigation being largely gone in for, of course, in both countries, and their results in tonnage to the acre far exceed those of Cuba and the Philippines. Java alone burns the cane leaf or trash in the furnaces, mixing this up with the " ampas," the latter being supplemented by about 9 per cent. of cane trash and 2 per cent. of firewood in most factories.

The Java factories are practically all only one stage high, being so constructed on account of volcanic disturbances which are felt from time to time; the evaporating plant and vacuum pans are on this floor and the crystallizers usually on the ground floor; the massecuite being pumped to the centrifugal mixers. Cuba specializes in "Gravity" houses many storeys high, the Hawaiian and Philippine houses being usually partially gravity, and not so high as the Cuban ones. Evaporating plants, vacuum pans and crystallizers are on the usual lines in all countries.

Dealing with my own product—the centrifugal machine—there are very many 30 in. diam. machines, both belt and water-driven in Java, the belt-driven type having the cast-iron "safety" framing so long popular in that country; but modern tendency is to install a machine of 36 in. or 40 in. and 42 in. diam., either belt or electrically driven with steel framing, My firm has supplied many large electrical installations in recent years of 36 in. and 42 in. diam.

In Cuba, Hawaii and the Philippines one size is practically standardized, namely 40 in. × 24 in., and electric, belt and water drives are all used. Most of these machines have flat-bottomed baskets, enabling discharging ploughs to be used if desired. Should ploughs not be used, the discharge valve, being a flat disc, is very light and can be easily handled, and from what I have seen, the contents of the basket can be as readily discharged by hand, as if the basket had the slightly sloped bottom. Self-discharging machines, that is machines with an open bottom, the massecuite being fed on to the usual bell-shaped valve or spreader plate fixed at the required height on the spindle, are also in use in Cuba, Hawaii and the Philippines, but neither these nor the flat-bottomed type of machine are used in Java.

One sees labour-saving devices of the very latest kind in the factories in Cuba, Hawaii and the Philippines where labour is very expensive. In Java where labour is extremely cheap, the factories are able to make use of the natives to carry out operations by hand, which could not be afforded in the other countries.

The "Proef" Station of Java is undoubtedly the finest in the world, dealing as it does with every feature of the sugar industry from the cultivation of cane in the fields to the supervision of the actual factory; though Cuba, Hawaii and the Philippines have institutions of a similar kind while not of nearly so extensive a nature. Cuba has always been troubled with cane fires, and it is significant that in all my travels in Java and the Philippines I never saw a cane fire at all. In Hawaii, on account of the density of the cane trash a "block" of cane is actually deliberately set fire to, to clear this, when the cane itself is then more easily accessible for cutting, and is of course then brought to the mill as soon as possible.

In conclusion, with double and single crushers, Searby shredders, large and small tandems, electric and steam drive, large and small centrifugals, cheap and expensive labour, who shall dare say which country is doing the the best work? Not the writer, at any rate!

"Celotex" bagasse boarding has a rival in Australia in the shape of "T-board," the chief constituents of which are bagasse and ti-tree bark, which latter forms a natural adhesive of remarkable value to the strength and tenacity of the boarding, furnishing a material, not only very effective, but also pleasing to the eye. "An inspection of this 'T-board' leaves no one in doubt as to its superiority to 'Celotex,' which the American manufacturers are now importing into Great Britain." It might be possible for Queensland to send "T-board" to the Mother Country, and other parts of Europe, while also obtaining considerable trade in Eastern countries.

Work with Sugar-Beets at the Tucumán Experiment Station.

By Dr. W. E. CROSS.

Director, Tucumán Experiment Station.

In view of the important developments with sugar beets in Louisiana at the present time, it may be interesting to give a short resumé of the work done with this crop in the Tucumán Experiment Station, one of the first institutions in sub-tropical countries to realize the possibility of growing both beet and cane in the same district, and treating them in the same factory.

We were inspired to take up this work through a variety of reasons. In the first place the writer of this article did considerable work on the application of the carbonation process to cane juices while in Louisiana in 1910-14, and had much correspondence with a sugar company in Arizona growing beets which were worked in a beet factory, cane also being planted to be worked up in the same factory, using the same clarification process, and indeed, as I remember, the same method of juice extraction, i.e., diffusion. In the second place, one of the technical men at this Station came from California, that important beet growing region, and frequently stated how similar the climate of Tucumán was to that of his "home" state. And in the third place, Tucumán is so situated geographically that it may possibly have to meet at some time the competition of the possible beet industry of the more temperate provinces, as well as that of the cane industry of the more northerly provinces, which are more tropical, and therefore obtain higher yields of sugar per ton of cane. For these and other reasons we thought that not only might Tucumán be able to produce the two crops, beet and cane, and treat them in the same factory, but also that this would be the only province of this Republic which could do this, as the temperate provinces would be too cold for cane, and the northerly more tropical provinces too hot for the sugar-beet.

Our experiments were begun in the year 1917, and have been continued ever since that time, both in the grounds of this Experiment Station. and also in co-operative experiments on plantations of various sugar factories in different parts of the province.

We first endeavoured to discover the best time for sowing the beets in this climate. Planting in the Spring (as is done in Europe) proved an absolute failure; as, although the plants germinated well, they quickly became the prey to a kind of wilt, and died off rapidly. The Autumn plantings, on the other hand, were a great success, as the plants developed rapidly during the winter, and were already ripe before the early summer came on, with its many insect pests and diseases. Having thus established definitely that the beets would have to be planted in the fall (April or May), we were able to proceed with the work systematically, studying the adaptability of the different varieties, as also the effects of irrigation, manures, etc., as well as determining the period of maturity of the beets, and studying the possibilities of storing them under our conditions.

VARIETIES STUDIED.

The varieties studied during the course of these experiments were the following : Gerard Haig, Productive Type, Sugar Type, and Petit Marshall, obtained from the United States in the early years of the work when it was impossible to obtain seed from Europe on account of the war.

Percy, another type from North America ; Dippe (produced in Michigan) : Kleinwanzlebener (seed produced in Michigan) ; Kleinwanzlebener Elite; Idaho. (The seed of these last four varieties was obtained from the Department of Agriculture in Washington). Sutton's Improved, Selection A, from England; Sutton's Improved, Selection B, from England; Sutton's White Red Top, from England; Sperling's, from North America; Race Fouquier, French, obtained in Buenos Aires; White Extra, seed obtained in Buenos Aires, imported from Europe; White Sugar Beet, seed obtained in Buenos Aires; White Improved Vilmorin, imported seed obtained in Buenos Aires; White Race Fouquier d'Hourel, from France; Vilmorin Improved, from France; Vilmorin Improved White Productive, seed obtained in Buenos Aires, imported from France; White Giant, seed obtained in Buenos Aires; Vigor, seed sold in New York, but of Italian origin; Kuhn & Company, from Holland; Two varieties we received from Sweden, under the names Pajbjerg and Wohanka; Janasz (Polish) seed, obtained from France.

Tonnage experiments were not commenced until the year 1919, the work of the years 1917 and 1918 being preliminary in nature, and limited to observing the development of the beets and testing their sucrose content. From 1919 on, regular tonnage tests have been carried out, in different experiments and with different varieties. The results obtained in these experiments are found in the resumé in Table I.

The experiments of the year 1919 were carried out with one variety only, with the idea of determining the effect of irrigation and manures on the production of beets. The results showed that both lime and stable manure produced increased yields of beets, whose sucrose content, however, was not so high as on similar land without manuring. This result is similar to that obtained with cane in this country, for nitrogenous manures give increased yields of cane, which is, however, less rich in sugar.

In 1921 a series of variety experiments were begun. In the different years different varieties were tried out, in comparison with two of the best classes for our conditions, the Kleinwanzlebener Elite and the Vilmorin Improved. The seed for the 1921 experiments was received late, so that it could not be sown until the 20th of June, which is rather too late for this climate; but, nevertheless, good yields of beets and sugar were obtained. In 1923 two large plantings were made, one early, on the 28th of April, and the other about a month later, on the 20th of May. The results showed clearly the advantage of the earlier sowing. In this year, owing to the climatic conditions, the yields of beets were not very high, but the sucrose content was better than usual. Sutton's White Red Top and the White Giant, which were tried out in this year, turned out to be beets of specially heavy production, but of relatively low sugar content.

In 1924 a number of varieties were tested with and without manuring. The effect of the manuring in this experiment, as in the previous one, was to increase the yield of beets, but to decrease slightly the sucrose content. The comparatively low sucrose content of the beets in this year was due to the late date of harvesting, as we shall show later on in this paper.

In the year 1925, one early planting and one late planting were made, the results obtained as regards tonnage being much in favour of the early sowing in the case of the Vilmorin Improved, but not so in the Janasz varieties. In all cases a better sucrose content was obtained by early sowing. In this year the variety Kuhn and Co. was tried out for the first time, giving excellent tonnage, although not a very good sucrose content, probably due here also to the late sowing.

It will be seen that almost all the varieties tried out gave fairly satisfactory results, especially when sown at the best period for this climate, i.e., as early after the 1st of April as possible. The specially good varieties were (taking into account yields, sugar contents, manner of growth, freedom from diseases, etc.); Vilmorin Improved; Kleinwanzlebener Elite; Kuhn & Co.: Kleinwanzlebener (Michigan); Vigor, and the Swedish varieties under the name of Wohanka and Pajbjerg.

A point which was studied with especial thoroughness in the investigation was that of the ripening of the beets, in order to discover what would be the best period in which to carry out the harvest on an industrial scale. To this end almost every year the beets of the different varieties were analysed frequently during the period from October to February, the analyses being made always on the basis of a mixed sample of a number of beets. We have thought the results obtained interesting enough to collect together in one Table (No. II).

RESULTS OBTAINED.

These results would appear to show that in general a maximum of ripeness is reached sometime between the middle of October and the beginning of February, according to the year, and perhaps also depending on the variety—and that after this the beets begin to diminish in sugar content. This is not due to any real process of deterioration, however, but is simply produced by the absorption of water by the beets in the period of heavy and continuous rains, as is shown by the fact that the purity does not diminish along with the sugar content, but only the Brix and sucrose of the juice in proportionate degree. For instance, in 1924-25 the maximum sucrose content was reached in the unmanured varieties in the second half of November, with an average of 16·70 per cent. for the four varieties (Table II). The average purity of these beets was 82·22 per cent. By the early part of January the sucrose content had gone down to 11·44 per cent., although the average purity was 81·29 per cent., or hardly any less than at the moment of maximum richness. This is similar to what takes place in this country when sugar cane is left without harvesting until the second harvest[1]; through the absorption of water the Brix and sucrose content diminish, during the rainy season, while the purity remains almost constant.

The tentative conclusions we have drawn from these results are that the beets should be sown as early as possible (about the 1st of April), and that the harvest should be begun about the middle of November, and finished before the beets get too watery, when the extra bulk of raw material to be handled would seriously affect the costs of manufacture.

Seeing that in this country the harvesting of the beets will have to take place in part during the rainy season, it will be necessary to store the beets to some extent to ensure the possibility of the regular working of the factory. We therefore carried out a number of experiments on the possibility of storing the beets under our conditions. To this end a large number of beets were weighed individually, and labelled. The sucrose content of an average sample of the beets the day they were harvested was 12·36 per cent. After seven days they had lost 10·3 per cent. of their weight, the sucrose content of an average sample being 14·3 per cent. A week later, the loss in weight was 16·60 per cent., and the sucrose content 18·0 per cent. In the third week the loss in weight had become 25·6 per cent., the sucrose content now being 17·8 per cent.; while a month after harvesting the loss in weight

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[1] *Revista Industrial y Agricola de Tucumán*, 1920, 11, p. 85.

TABLE I.

				Kilos Beets per hectare.	Tons per acre.	Average weight of Beets (grms).	Sucrose in Beets per cent.	Purity of Juice per cent	Kilos Sucrose per hectare.	Tons Sucrose per acre.
A	May 15th, 1919	Nov. 20th, 1919	Productive Type (irrigated)	51348	20·53	—	14·47	—	—	—
	” ” ”	” ” ”	Productive Type (non-irrigated)	55744	22·30	—	11·53	—	—	—
	” ” ”	” ” ”	Productive Type, manured land (irrigated)	64735	25·92	—	11·40	—	—	—
	” ” ”	” ” ”	Productive Type, limed land (irrigated)	62337	24·93	—	12·07	—	—	—
B	June 20th, 1921	Dec. 5th, 1921	Dippe	39100	15·64	—	12·42	—	—	—
	” ” ”	” ” ”	Kleinwanzlebener, Michigan	37700	15·08	—	12·34	—	—	—
	” ” ”	” ” ”	Kleinwanzlebener, Elite	38400	14·56	—	12·08	—	—	—
	” ” ”	” ” ”	Idaho	41000	16·40	—	12·04	—	—	—
C	April 28th, 1923	Jan. 10th, 1924	Sutton's Improved, Selection A	24000	9·60	377	15·35	84·37	3684	1·47
	” ” ”	” ” ”	Sutton's Improved Selection B	20400	8·16	305	17·55	87·71	3580	1·43
	” ” ”	” ” ”	Sutton's White Red Top	36400	14·56	505	10·80	69·11	3931	1·57
	” ” ”	” ” ”	Idaho	22058	8·82	334	16·90	89·89	3728	1·48
	” ” ”	” ” ”	Kleinwanzlebener Elite	22628	9·04	350	16·25	86·60	3677	1·46
	” ” ”	” ” ”	Sperling's	21428	8·56	382	16·30	86·25	3493	1·39
	” ” ”	” ” ”	Race Fouquier	20114	8·04	332	13·50	81·96	2715	1·08
	” ” ”	” ” ”	White Extra	20229	8·08	329	15·80	84·14	3196	1·27
	” ” ”	” ” ”	Vilmorin Improved	25086	10·01	348	14·40	85·50	3613	1·46
	” ” ”	” ” ”	White Sugar Beet	22857	9·14	365	13·20	82·36	3017	1·20
	” ” ”	” ” ”	White Race Fouquier d'Hourel	24800	9·92	338	12·30	84·61	3050	1·22
	” ” ”	” ” ”	White Improved Vilmorin	21300	8·52	308	15·15	84·88	3226	1·28
	” ” ”	” ” ”	Vilmorin Improved White Productive	22300	8·92	302	15·20	81·61	3389	1·35

				Kilos Beets per hectare.	Tons per acre	Average weight of Beets (grms).	Sucrose in Beets per cent	Purity of Juice per cent.	Kilos Sucrose per hectare.	Tons Sucrose per acre.
D	May 20th, 1923	Jan. 10th, 1924	Sperling's	16133	6·45	336	14·60	83·45	2355	0·94
	,, ,, ,,	,, ,, ,,	Kleinwanzlebener Elite	15467	6·18	382	15·20	82·51	2350	0·94
	,, ,, ,,	,, ,, ,,	Idaho	10133	4·05	241	16·20	84·73	1641	0·65
	,, ,, ,,	,, ,, ,,	White Extra	18000	7·20	350	14·20	82·58	2669	1·06
	,, ,, ,,	,, ,, ,,	Race Fouquier	17333	6·93	317	16·00	84·93	2773	1·10
	,, ,, ,,	,, ,, ,,	Vilmorin Improved	16667	6·66	279	17·40	86·20	2900	1·16
	,, ,, ,,	,, ,, ,,	White Giant	39067	15·62	519	7·45	60·83	2910	1·16
	,, ,, ,,	,, ,, ,,	Vigor	17533	7·00	306	15·50	84·57	2717	1·18
E	April 24th, 1924	Feb. 3rd, 1925	Vilmorin Improved (un-manured)	38961	15·58	931	11·40	84·07	4441	1·77
	,, ,, ,,	,, ,, ,,	Kuhn and Co. (un-manured)	32749	12·90	820	11·20	79·66	3667	1·46
	,, ,, ,,	,, ,, ,,	Wohanka (un-manured)	43987	17·60	822	11·30	83·49	4970	1·78
	,, ,, ,,	,, ,, ,,	Pajbjerg (un-manured)	53953	21·58	983	11·20	82·80	6042	2·41
F	June 7th, 1924	,, ,, ,,	Vigor (un-manured)	33529	13·41	695	9·55	74·40	3202	1·28
G	April 24th, 1924	,, ,, ,,	Vilmorin Improved (manured)	65707	26·28	1238	10·50	79·79	6899	2·76
	,, ,, ,,	,, ,, ,,	Kuhn and Co. (manured)	44911	17·96	1518	9·90	76·43	4446	1·77
	,, ,, ,,	,, ,, ,,	Wohanka (manured)	65452	26·18	1344	10·50	80·26	6872	2·75
	,, ,, ,,	,, ,, ,,	Pajbjerg (manured)	57621	23·04	1239	8·12	83·42	4678	1·96
	,, ,, ,,	,, ,, ,,	Kleinwanzlebener Elite (manured)	34247	13·69	—	10·05	78·02	2899	1·16
	,, ,, ,,	,, ,, ,,	Kleinwanzlebener Michigan (manured)	58686	23·47	1250	11·60	81·16	6807	2·72
H	April 1st, 1925	Nov. 28th, 1925	Vilmorin Improved	27344	10·93	557	15·60	89·31	4258	1·70
	,, ,, ,,	,, ,, ,,	Janasz No. 1	25200	10·08	498	17·25	91·36	4448	1·77
	,, ,, ,,	,, ,, ,,	Janasz No. 2	20656	8·26	398	16·25	89·31	3356	1·34
	,, ,, ,,	,, ,, ,,	Vigor	31776	12·70	532	17·10	88·80	5433	2·17
I	May 23rd, 1925	Jan. 6th, 1926	Kuhn and Co.	59466	23·78	866	10·20	76·35	6065	2·42
J	May 16th, 1925	Jan. 5th, 1926	Vigor	25703	10·28	575	8·20	63·32	2107	0·84
	,, ,, ,,	,, ,, ,,	Janasz No. 1	26889	10·75	605	10·50	72·51	2823	1·12
	,, ,, ,,	,, ,, ,,	Janasz No. 2	25592	10·23	459	11·15	69·96	2841	1·13
	,, ,, ,,	,, ,, ,,	Vilmorin Improved	22444	8·97	685	11·55	75·55	2592	1·03
	,, ,, ,,	,, ,, ,,	Wohanka	14889	5·95	616	9·90	71·99	1474	0·58
	,, ,, ,,	,, ,, ,,	Pajbjerg	18000	7·20	598	10·70	75·17	1926	0·76

TABLE II.

Year.	Variety.	Sucrose in Beets per cent 15th-31st October.	1st-15th November.	15th-30th November.	1st-15th December.	15th-31st December.	1st-15th January.	15th-31st January.	1st-15th February.
1918-19	Gerard Haig	8·56	10·40	10·10	13·10	10·5	15·10	—	12·00
	Productive Type	8·25	10·60	11·00	13·60	13·40	15·30	—	14·80
	Sugar Type	11·10	7·90	11·90	13·00	12·20	13·80	—	15·40
	Petit Marshall	9·75	9·80	9·60	13·80	12·30	13·50	—	15·20
	Percy	8·15	11·40	10·40	11·80	12·00	16·60	—	—
1919-20	Productive Type (irrigated)	—	13·67	13·60	12·80	13·00	11·50	13·07	—
	Productive Type (non-irrigated)	—	13·47	11·53	11·70	12·04	12·40	12·13	—
	Productive Type (manured)	—	13·20	12·06	11·85	11·84	11·33	10·22	—
	Productive Type (limed)	—	—	13·07	11·73	14·03	13·83	10·93	—
921-22	Dippe	—	10·03	8·63	—	13·43	13·40	13·20	14·11
	Kleinwanzlebener (Michigan)	—	10·57	9·03	—	12·63	15·30	15·70	11·59
	Kleinwanzlebener Elite	—	9·57	9·62	—	11·87	14·67	14·80	12·00
	Idaho	—	9·87	9·83	—	12·27	14·07	13·60	12·46
923-24	Sutton's Improved Selection A	—	—	14·20	—	10·80	15·35	—	—
	Sutton's Improved Selection B	—	—	14·60	—	12·00	17·55	—	—
	Sutton's White Red Top	—	—	8·00	—	6·00	10·80	—	—
	Idaho	—	—	13·60	—	14·30	16·90	—	—
	Kleinwanzlebener Elite	—	—	15·20	—	12·40	16·25	—	—
	Sperling's	—	—	12·80	—	12·80	16·30	—	—
	Race Fouquier	—	—	13·80	—	12·00	13·50	—	—
	Vilmorin Improved	—	—	13·20	—	11·80	14·40	—	—
	White Sugar Beet	—	—	15·20	—	12·80	13·20	—	—
	White Race Fouquier d'Hourel	—	—	13·40	—	12·20	12·30	—	—
	White Improved Vilmorin	—	—	15·50	—	15·60	15·15	—	—
	Vilmorin Improved White Productive	—	—	14·80	—	14·00	15·20	—	—
	White Extra	—	—	15·20	—	13·00	15·80	—	—

Year.	Variety.	Sucrose in Beets per Cent. 15th-31st October.	1st-15th November.	15th-30th November.	1st-15th December.	15th-31st December.	1st-15th January.	15th-31st January.	1st-15th February.
1924-25 ..	Vilmorin Improved	13·00	14·20	15·60	14·88	12·08	10·90	9·85	—
	,, ,, (manured)	10·80	10·50	12·65	13·20	9·45	9·95	9·85	—
	Wohanka	14·05	15·22	17·92	14·30	12·83	12·05	12 80	—
	,, (manured)	12·25	13·12	12·60	13·30	10·83	9·00	11·17	—
	Kuhn and Co.	12·00	14·00	17·05	13·65	13·41	9·80	11·40	—
	,, ,, ,, (manured)	13·75	12·62	15·05	12·92	12·35	12·10	11·10	—
	Pajbjerg	12·30	13·90	16·22	14·95	11·51	13·00	11·50	—
	,, (manured)	12·10	15·60	15·06	13·60	10·83	10·00	11·82	—
	Kleinwanzlebener Elite (manured)	11·35	12·35	12·52	12·75	9·94	12·20	11·12	—
	Kleinwanzlebener Michigan (manured)	12·65	13·06	13·67	13·70	9·43	10·40	11·07	—
925-26 ..	Vilmorin Improved (early Planting)	12·05	14·55	15·50	15·60	—	—	—	—
	Vilmorin Improved (late Planting)	9·80	10·00	9·45	10·80	10·50	11·55	—	—
	Janasz No. 1 (early planting)	15·75	18·20	17·85	17·25	—	—	—	—
	Janasz No. 1 (late planting)	10·40	11·00	12·60	14·15	13·00	10·50	—	—
	Janasz No. 2 (early planting)	16·00	16·45	17·30	16·25	—	—	—	—
	Janasz No. 2 (late planting)	12·30	14·55	10·45	13·15	12·20	11·15	—	—
	Vigor (early planting)	13·50	16·25	13·80	17·10	—	—	—	—
	Vigor (late planting)	10·80	9·05	10·20	8·70	10·95	8·20	—	—
	Kuhn and Co. (late planting)	13·60	11·75	12·35	10·90	13·45	11·40	—	—
	Wohanka (late planting)	10·35	11·35	9·75	10·15	10·70	9·90	—	—
	Pajbjerg (late planting)	11·30	11·70	10·05	12·45	12·40	10·70	—	—

was 39·0 per cent, the sucrose content being 22·2 per cent. We were thus able to show that it would be quite feasible to store the beets during the few days necessary to ensure the even working of the factory in spite of the rains, without serious losses ensuing; this is in strong contrast with the cane, especially the Java varieties grown here, which in those summer months when the beets are harvested deteriorate after cutting with extreme rapidity, being hardly of any use for grinding after three or four days.

We do not need to say much here about the methods of cultivation employed. The beets were sown in rows, of 50 cms. apart; a continuous line of seed was first sown, afterwards thinning out the plants until they were from 15·25 cms. apart in the row. The land was irrigated before sowing, and also after the plants were "up," three or four times as was necessary. The middles were cleaned by cultivating with a small cultivator.

It is to be noted that the fact that the beets can be grown in this province during the winter is of immense advantage, as during that season of the year, which is naturally very dry, we have practically no weeds. The costs of cultivation are thus cut down to a minimum—in contrast to what they would be with a summer crop of this nature, for which considerable hoe work would be required.

Modification of Cane Factory necessary.

A very interesting problem connected with this work is as to what extent a modern cane sugar factory will have to be modified to be able to deal with beets, assuming that, as is the case in Tucumán, the harvesting periods for the two crops respectively will occur in different seasons of the year.

In accordance with the usual beet practice, a slicing machine and diffusion batteries would have to be installed, as well as carbonation tanks, lime kilns, etc. But it is possible that these additional installations would not be necessary, for it must be remembered that the present methods employed in the manufacture of beet sugar were developed long before the cane industry had reached its present high level of perfection. For instance, it may well be possible to do without the carbonation process of clarification, which would be so expensive in this province where lime is scarce. It is possible that an adequate clarification of the beet juices could be obtained by liming and sulphuring, as is done in the cane process, using kieselguhr as a subsidiary clarifying agent, and filtering all the juice through presses. This process would be immediately applicable to the greater part of the Tucumán factories, which already filter the whole of the juice without recourse to decantation. I suggested this idea some years ago and have recently found it confirmed by some experiments published by D. C. Morris[1] in which he showed that raw beet juice could be filtered with an economical rate of flow in ordinary filter-presses, by using between 3 and 6 lbs. of "HyFlo Supercel" per ton of beets. He found that the kieselguhr not only aided the filtration, but actually produced a very considerable purification of the juice, by the absorption of impurities. This process would not be too expensive if it were combined with the regeneration of the kieselguhr, in which much progress has been made recently in North America.

It may also be possible to extract the beet juice by the powerful modern cane mills. In the old days, before the diffusion process was accepted in France, a number of "continuous presses" were invented which had much in common with our present cane mill, the principal difficulty apparently being in making the beet pulp pass through the mills, i.e., making the mills "bite," recourse being had to a carrier which passed between the rolls, taking the pulp along with it. This, of course, was an expensive and cumbrous method, and was given up eventually in favour of the diffusion. Now that the problem may come up again, however, for factories which already have powerful mills installed, some inventive genius may devise a plan of extracting the beet juice with these mills, economically and successfully.

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[1] *I.S.J.*, 1925, 479.

With regard to diseases and pests of the beet in this country, I would say that when grown during the winter months our plants have happily been reasonably free from troubles of this kind. We have, however, a form of "Curly-Top," which our Pathological Department under the skilful direction of Mr. G. L. FAWCETT, has found to be somewhat different from the Curly-Top of North America, being transmitted by the insect *Aceratogallia sanguinolenta.*[1] The amount of damage done to the beets grown during the winter, by this disease, is, however, relatively small.

Froghopper Pest of Sugar Cane in Trinidad.

Reference has already been made in our pages to the incidence of the froghopper pest in Trinidad and to the creation of a permanent committee charged with the duty of investigating the pest, and to the lines along which the committee propose to work.[2]

The committee has started its campaign, and several workers are now definitely engaged on their allotted problems. A notable contribution has been made by the publication of the first part of a series of studies by Dr. C. L. WITHYCOMBE,[3] who has been engaged for several years before the formation of the Froghopper Committee in studies relating to this insect. This paper presents a general survey of the position, embracing the work of previous observers and embodying important observations made by the author during the past three years.

In the first place reference is made to the investigations of HART and WILLIAMS, and in particular to the Report of the latter,[4] which summarizes the information available up to the time of its publication. It is recommended that this Memoir should be consulted with regard to many details and supplementary evidence in connexion with the present paper.

At the outset the statement is made that after reading WILLIAMS' report it is quite evident, from the apparently conflicting circumstances associated with the "blight," that an enormous number of factors are involved no one of which can be isolated as the principal cause. In the main, however, the disease seems to be governed by environmental conditions, some of which are capable of alteration by agricultural methods and others over which we have as yet no control; and thus there is an immense field of research awaiting any investigator in meteorology, agricultural engineering, soil science and plant and insect physiology, to mention only a few of the many varied aspects.

It is with full recognition of these aspects of the case that the committee has planned that the work shall be undertaken over a very wide range at the hands of several workers and that this work shall proceed continuously over a series of years. The present study is a valuable contribution towards an understanding of the pest, and its findings and conclusions will be of material service with regard to the full study of the intricate problems involved.

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[1] *Revista Industrial y Agricola de Tucumán*, 1925, 16, p. 40.

[2] *I.S.J.*, 1925, p. 585; 1926, p. 78.

[3] Studies on the Aetiology of the Froghopper Blight in Trinidad. Part I, Introduction and General Survey, by C. L. WITHYCOMBE, Ph.D., D.I.C. *Ann. Applied Biology*, Vol. XIII, No. 1, Feb., 1926.

[4] Memoir No. 1 Dept. of Agr. Trinidad and Tobago, 1921, Froghopper Blight of Sugar Cane in Trinidad, by C. B. WILLIAMS.

In this first of the series of studies, attention is given to the interrelations of the sugar cane plant and the froghopper; and there is an attempt to offer explanations of some of the previously observed, though vaguely understood, phenomena and to attempt their co-ordination; much original work was carried out in order to obtain the data necessary for this. Little reference is made to the factors controlling the number of the froghoppers themselves, attention being dircted rather to the conditions influencing the resistance of the canes to, and the recovery from, froghopper attack.

The studies and observations are recorded under several heads, which include the bionomics of the froghopper with an account of the insect in its various stages together with its mode of feeding and the mechanism by which this is effected. This is followed by a study of the sugar cane and its several parts, the anatomical structure of the plant as affecting the relationship to the attacking insect being carefully dealt with. As stress is now laid on the reactions of plant tissues and their contents, these were investigated; and the H-ion values of the different tissues recorded in their normal condition and as influenced by froghopper attack.

The effect, upon the leaf, of froghopper sucking is the subject of an interesting section and this is followed by one dealing with the conditions influencing the spread of the leaf injury caused by the attack of the insect; in both these sections interesting and valuable original work is recorded, greatly extending our knowledge of the nature of the attack. Sections are devoted to the root system and its relation to resistance or susceptibility to attack and to recovery after attack, and to the stem and the effect of the froghopper blight thereon.

The effect of soil conditions is discussed in some detail, and here it is stated that a survey undertaken to ascertain the H-ion content of various soils led to the conclusion that the acidity of the soil could not be correlated with froghopper attack, but the view is expressed that the most important factor is the water balance of the plant; if this is unfavourable the canes are susceptible to attack, and recovery is hindered, while where the water relationship is favourable the canes are less susceptible and, if attacked, have better chances of recovery. Attention is drawn to the point that the condition of the soil largely influences the water balance; if the soil is unduly dry as the result of drought the canes suffer. But mere dryness of the soil is not the only consideration, for the roots of the cane are unable to take up water effectively unless they are properly aerated; consequently, if soil aeration is defective, the water balance may be unfavourably affected. This condition may arise from more than one cause, including imperfect tillage, which results in undue compactness, or waterlogging due to imperfect drainage or too heavy rainfall, or to all combined; thus it is possible for the canes to suffer from water shortage even when there is an abundance of water in the soil. As it is generally recognised that good tillage and good agricultural methods are the best weapons for warding off and ameliorating attacks of froghoppers, the observations recorded in this section have particular and direct bearing.

A section relating to the effect of fertilizers in aiding recovery contains information which will appeal to the planter. While it is recognized that the judicious use of fertilizers is of value in helping to create healthy, vigorous canes when the soil and other conditions are favourable, it is pointed out that unless the added fertilizers have the effect of flocculating the soil and thus assisting aeration, or in other ways enabling the soil to yield water to the plant freely, they may do more harm than good; further observations on this aspect of the matter are promised in a future paper.

Finally, there is a section on the effect of rainfall. Advantage is taken of the observations recorded and discussed by WILLIAMS, whose findings are endorsed, that moderate rainfall for both wet and dry seasons is associated with decrease in the amount of blight, while excessive dryness or excessive rain for either season tends to favour increased blight.

In summing up, the author points out that *Monecphora* (*Tomaspis*) *saccharina*, Dist. is a natural denizen of cane and grass fields, is indigenous to the island and not an introduced pest. It is observed that the injury done is not necessarily directly related to the number of froghoppers present. The amount of injury is rather determined by environmental conditions, particularly by the water balance, which largely influences the susceptibility of the cane; and it is suggested that cane leaves with a sub-normal water content may be more attractive to the insects, in that they contain carbohydrates, in a less advanced stage of condensation and more available to the insect than those of normal leaves. Various other conditions of the leaves as influencing froghopper attack are discussed.

General observations indicate that the froghopper exhibits some, but no very marked, preference amongst canes; but when increased numbers are found localized in fields of specially susceptible canes, this is usually due to other causes not yet fully understood.

The effect of the sucking of the froghopper upon the cane can be briefly outlined as a removal of water, carbohydrates, proteins, etc. Withdrawal of water alone from the cells of the leaf results in a local water deficit, and this tends to be corrected if the osmotic pressure of the cell sap is increased to such an extent that water passes into the deficient cells from the surrounding tissues. Increase in osmotic pressure in the cell sap, is, however, commonly effected by hydrolosis of carbohydrates and the decomposition of other complex molecules to simpler structures; but as rapidly as these hydrolytic products are formed, they are removed by the insect, whose saliva also assists in the decomposition processes. It is clear that a state can be reached in which the physiological equilibrium of the plant cell has been so far thrown over that recovery, even with ample and immediate water supply, is impossible.

The translocation of water and food material is undoubtedly interfered with by the changes caused, by the effect of sucking, on the cells of the border parenchyma and of the phloem and other vascular tissues of the leaf. At the same time the enzymes of the froghopper saliva cause progressive death of adjacent tissues, thus giving rise to the extensive dead areas characteristic of the attack.

It is pointed out that the saliva injected into the leaves is responsible for many changes; this saliva, in conjunction with the oxydases of the plant, gives rise to the red coloration usually observed in the neighbourhood of the injury. But more important is the effect on the H-ion content of the cell sap, increased acidity being almost certainly due to oxidation; this increased acidity probably brings the tissues of the cells involved nearer to the optimum for the insect's salivary enzymes and also for those of the plant which have been released, thus facilitating the spread of the injury. The lowering of the H-ion content of the cell sap of the cane is a marked pathological symptom, and canes which show but slight lowering usually recover; a rapid and considerable drop is associated with canes liable to succumb. This being so, it appears evident that colloids and other substances capable of exerting a buffer influence in respect to H-ion changes are likely to have effect in enabling canes to withstand attack; and it is noted that the more resistant canes, such as Uba, are characterized by high colloidal content. Decreased susceptibility to froghopper may be inseparable from increased colloid content of the cane sap, and, should this prove to be true, a good cane for froghopper conditions will probably be a poor cane from the point of view of the sugar manufacturer.

The loss of active leaf surface resulting from froghopper injury may be very considerable, and the canes then present an appearance such as if a fire had passed through them. The reduction of photosynthesizing surface must result directly in a corresponding reduction in the supply of elaborated products. This accounts for the small, starved internodes of the stem which are laid down during the course of the blight. Further, the pathological changes already noted in the leaf may continue in the stem from the top downwards; the top, being itself richer in oxidases, is the first to show a rise in H-ion concentration. With rise in H-ion concentration and continued enzyme activity, carbohydrates are hydrolysed in the stem, and it is likely that the increased osmotic concentration of the cell sap is responsible for the shooting of the eyes lower down the stem—another feature of blighted canes. Recovery of the stem is only possible with renewed leaf surface and renewed power of photosynthesis. This necessitates ample water with required solutes from the soil. The soil may be, and often is on badly blighted fields, physically or physiologically retentive of its water so far as the plant is concerned; heavy clays and badly aerated or toxic soils being in mind. Fertlilizers have not been found beneficial at this critical time. They may possibly increase the osmotic pressure of the soil solution by a small fraction, but not sufficiently to affect a struggling cane.

Suggestions for consideration and trial are based on the general observations put forward, and they are discussed under three heads.

The first suggestion is that cane varieties most suitable to the soil conditions should be sought for and cultivated. Canes likely to withstand froghopper attack best are such as can maintain a water content, well above the wilting point, under adverse conditions.

The second suggestion is that, as far as possible, a high water content should be maintained in the cane plants: as affecting this, the maintenance of a humid atmosphere around the leaves and shading them from light to reduce transpiration are tentatively mentioned.

The third suggestion embodies points of fundamental importance, so the author's observations are given in extenso: "An endeavour should be made to increase the available water in the soil. Water may be unavailable to the cane (1) from actual deficiency, or (2) from physiological unavailability. Actual deficiency of water may occur during the wet season, especially in the time of the Indian summer or *petit careme*. A dry spell during the wet season while froghoppers are abundant is disastrous, especially upon infertile soils, where plants exhibit a greater water requirement. Physiological unavailability of water may result from many conditions: (1) High content of hydrophyllic colloids, such as is found in very heavy clay soils; this is noteworthy in several districts in Trinidad. (2) Oxygen deficiency in the soil. This again obtains especially on heavy compacted clay soils in a bad state of tilth, as they have a lower oxygen content than more open soils even under the same rainfall conditions. LIVINGSTONE and FREE state that interference with water absorption by the roots is the first result of the reduction of the oxygen content of the soil. Roots die with prolonged lack of oxygen, and drought following upon this is dangerous. Waterlogged soils again are lacking in aeration. Severe blight has been noticed on several occasions as a result of waterlogging and defective drainage. There are indications occasionally suggesting that an impermeable subsoil pan may be interfering with drainage and that such may be responsible for very local intensification of damage. This might be very difficult to rectify. (3) Soil toxicity of various kinds, inorganic and organic. Root development and intake of water are interfered with on toxic soils. (4) A poor root system ; canes on compacted or toxic soils often have ill-developed roots. The same applies to canes affected with root disease, and it is probable that nymphs of froghoppers feeding upon the roots have a deleterious effect upon root development. All these factors may be interdependent. Fertilizers applied at the surface may sometimes have a bad effect by inducing superficial root formation which is dangerous in time of drought. (5) High soil temperature. In certain rare cases of blight, following upon weeding and trashing of the canes, which may be done by planters in the hope of reducing the numbers of froghoppers at the last moment, it is possible that greater exposure of the soil to the rays of the sun, particularly at mid-day, may produce a soil temperature sufficiently high to retard root absorption at a time when water is most needed by the leaves. (6) High osmotic concentration of the soil solution ; this is unlikely to occur in ordinary soils, but is a possibility to be borne in mind."

The foregoing suggestions stress the need for careful attention to sound methods of agricultural practice, including thorough tilling and draining, as being most likely to maintain the health and vigour of the canes, by maintaining the proper water and food supply. Liming, it is suggested, is probably of value under this heading rather than for the direct correction of soil acidity ; although it may be pointed out that this correction is associated with the desired flocculation and aeration of the soil. Mention is made of the use of phosphatic fertilizers as possibly assisting to flocculate heavy clays, correcting toxicity arising from aluminium compounds, and stimulating root development ; but conclusive experiments on these points are lacking. As it has been suggested that flooding the land with water might be useful in destroying froghoppers in the nymph stage, it may be useful to record the writer's opinion that this is not likely to be effective, as the nymphs ascend the stem with a rise of water level ; to be effective the flooding would have to be complete.

F. W.

A method of utilizing beet tops developed by the Maschinenfabrik " Imperial," of Meissen, Germany,[1] consists in washing and slicing them and drying them down to 10 per cent. of water, thus obtaining a valuable cattle food, containing, according to an analysis made by the Saxony Chamber of Agriculture : Sugar, 23.6 ; protein, 10.9 ; mineral matter, 12.9 ; and fat, 1.2 per cent. Drying, including fuel, labour, depreciation and repairs, is estimated to cost 30s. per ton of dry material, the selling price of which in Germany is £7 to £7 10s. per ton ; whereas the undried material is valued at about 8s. per ton, equivalent to about £2 per ton, calculated on the dry basis.

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[1] *Ind. Chem*, 1926, 240.

Investigation on the Dehydration of the Beet (De Vecchis Process).[1]

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INTRODUCTION.

Subsequent to the publication of the Report of a Commission of Enquiry on the De Vecchis Process,[2] a company in which Sir CHARLES COTTIER was interested (Home and Colonial Investments, Ltd.) acquired the patents governing the De Vecchis process[3] (with the exception of the Italian rights), and presented the British Patents to the Minister of Agriculture and Fisheries. Attached to the gift was a stipulation that the Ministry should arrange for experimental work on the process by the Institute of Agricultural Engineering at Oxford. This work has now been commenced.

Research was instituted on the laboratory scale, and preliminary trials were also begun on the small-scale drying of beet in mass, the products being treated in a lixiviation battery, and the juice obtained purified by a modified system of purification. Upon the termination of this small-scale work, the scheme was transferred to a newly erected Research Station at Eynsham, six miles from Oxford, in the main building of which is placed plant for the treatment of sugar beet (1200 tons of roots per annum).

DRYING.

In the dehydration process, the difficulty was to effect the operation without causing caramelization or inversion of the sugar present. In attacking the problem, the idea in view was to blow air through the material, and not over it, thus the better to ensure the saturation of the air with moisture. Other considerations in mind were that the thinner the cossettes, and the more surface they expose to the air per unit weight, the more rapidly should it be possible to dry them. Further, that a current of air should be caused to pass through partially dried material, then while still unsaturated passed through fresh moist cossettes until completely saturated.

So long as the temperature to which dried or practically dried cossettes were exposed did not exceed 110°C. (230°F.) it was found that no formation of invert sugar or caramel occurred, while dehydrating down to 7½ per cent. of water. It was found essential to remove the moisture quickly, and the best results were obtained when the duration of drying was reduced to one hour or less. These experiments were done in a 5-belt conveyor dryer on the same general lines as that used by Dr. DE VECCHIS, but modified in certain details. It was observed that the desiccated material could be kept quite satisfactorily for about six months, and there does not appear to be any indication that it is necessary to reduce the moisture below 7½ per cent.

EXTRACTION, PURIFICATION, CRYSTALLIZATION, ETC.

Syrups of 50° Brix were obtained by lixiviation of cossettes dried for periods from 1 to 3½ hours; and this operation could probably be carried out in a continuous apparatus, using disintegrated material. Purification is still under investigation. It was anticipated that in dealing with syrups of 50° Brix, and of corresponding viscosity, the purification necessary for boiling to a good class of sugar would not be an absolutely simple matter. In some cases, following the defecation with lime and superphosphate, a single filtration only was sufficient, but this depended on the quality of the beets. An endeavour is being made to standardize a process which can be used in an equally satisfactory manner with all classes and strengths of syrups without any material addition to plant or labour. Boiling crystallization and curing presented no difficulty and sugar was produced of 99 per cent. polarization.

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[1] Condensed from "Investigations into the Desiccation (De Vecchis) Process for producing Sugar from Sugar Beet," Ministry of Agriculture. (Published by H. M. Stationery Office, 1926, Price, 4d.).

[2] *I.S.J.*, 1925, 158.

[3] *I.S.J.*, 1926, 110.

Economies of the Desiccation Process.

The main simplification in sugar production by the desiccation process arises from the fact that in the lixiviation of dried cossettes a juice is obtained which has a density of 50° Brix, whereas in the diffusion process the raw juice has a density of only about 16° Brix. In other words, the amount of liquid which has to be handled under the desiccation process is less than one-third of that which has to be handled in the diffusion process. As it is an essential in either process that this liquid be heated (the temperature required is the same in both processes), it follows that the quantity of heat required for lixiviation is only about one-third of that required for diffusion.

In addition to this, as the lixiviation process may be continued throughout the year, or three times as long as the diffusion process, and as the dried beet is only half the bulk of the fresh, the size of the lixiviation battery need only be one-sixth the size of a diffusion battery for the same annual production of sugar. The desiccation process admits of the adoption of a comparatively simple method : lime is added and the excess is subsequently neutralized with lime superphosphate ; the whole operation takes place in one tank, and only one filtration is required.

Several savings are effected by this simplified method of purification : it dispenses with carbonation tanks, lime-kilns and carbon dioxide pumps, and only requires one battery of filter-presses, less in size than in the other method. Not only, therefore, are capital costs reduced, but less labour is required for working. Again as the juice is only one-third the quantity and is only heated once, and as the carbon dioxide and circulating pumps are eliminated, a much smaller amount of steam is needed for power, and the consumption of steam for purification is approximately only one-twelfth of that needed in double carbonation. As the thick-juice in the desiccation process is already at 50° Brix, and may be denser, multiple-effect evaporation is dispensed with, the juice after purification going direct to the graining pans. The evaporation of the thin-juice requires one-third of the total steam consumed in the whole diffusion process. As the juice in the desiccation process is 50° Brix, whereas at this stage the juice in the diffusion process is 60° Brix, the heat units required are approximately 20 per cent. more than are needed in the diffusion process. Therefore the vacuum pans instead of being one-third will be about one-half of the capacity of those used in a diffusion factory of similar output.

Comparative Steam Consumptions.

The following tables give an approximate comparison of the water evaporated and the consumption of steam per ton of beet in the two processes of desiccation and diffusion.

TABLE I.—APPROXIMATE COMPARISON OF WATER EVAPORATED PER TON OF BEET IN THE TWO PROCESSES.

Diffusion Process.		Desiccation Process.	Lbs.
Total water evaporated[1]	2356 lbs.	Water evaporated in dryer ..	1680
		From thick-juice in vacuum pans..................	411
		Total water evaporated ..	2091

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[1] It should be noted, however, that in the diffusion system the bulk of the water is eliminated in the multiple-effect evaporators, which afford a very economical means of operating. As a result the total consumption of coal is lower in the diffusion system.

TABLE II.—CONSUMPTION OF STEAM FOR SUGAR EXTRACTION CALCULATED PER TON OF FRESH BEETS.

Stage.	Diffusion Process.[1] Lbs		Desiccation Process. Lbs.
Diffusion or Lixiviation	236·9	..	79·0
Purification	492·1	..	40.0
Evaporation	635·0	..	—
Heating Syrups and Boiling	244·0	..	296·4
Engines	341·6	..	85·4
	1949·6	..	500·8

At an evaporation of 10 *lbs. water per lb. of. coal* :—

= 194·9 lbs. per ton .. = 50·08 lbs. per ton.
= 8·7 per cent. .. = 2·23 per cent. (excluding fuel for drying,

COMPARATIVE CAPITAL COSTS.

Estimates were prepared for (1) capital and (2) working costs of factories of 100 and 25 thousand tons of fresh beets per annum, these being based on information from the results at Eynsham Research Station, from the data obtained by the inspection of two factories in Italy working the De Vecchis process, and from manufacturers' quotations.

(1) *Capital costs* :—Buildings required for drying and storage are more than offset by the smaller space required for the extraction and power plants, which become considerably reduced. In the estimates for a 100,000-ton desiccation factory, the total floor space is taken at 20 per cent. less than for a diffusion factory. As regards plant and equipment, 500 h.p. are required during the 100 days in which both drying and extracting are proceeding, this being reduced to 100 h.p. during the rest of the year.

Items	100,000 Tons of Beet per annum.		25,000 Tons of Beet per annum
Land and Sidings	£14,000	..	£6,000
Buildings, Roads and Flumes	40,000	..	11,000
Plant and Equipment	105,000	..	37,500
Contingencies	16,000	..	5,500
	£175,000	..	£60,000
Capital Expenditure per ton of fresh beet	£1 15s. 0d.	..	£2 8s. 0d.

COMPARATIVE COSTS OF PRODUCTION.

Fuel.—Air can leave the dryer saturated at 120° F.; if it enters the heater saturated at 80° F., and leaves the dryer saturated at 120° F., 1 lb. of water will be removed by 17·1 lbs. of air, and 1285 B.Th.U. must be supplied to this quantity of air to furnish the necessary heat (no allowance being made for radiation losses or for heat retained in the dried material). In this calculation, on which the fuel estimates are based, an allowance is made of 6¼ per cent. for radiation losses, which is considered to be sufficient. The B.Th.U. required per ton of beet dried are : 2240 × 0·75 × 1285 = 2,160,000. Presuming that the whole of the exhaust steam from the power required for the washing and slicing, and operating fans and dryers is utilized, the amount of steam available, at 40 lbs. steam per H.P. hour is 400 × 40 = 16,000 lbs. per hour. The rate of drying is 41·6 tons per hour, so that the B.Th.U.

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[1] Figures from McIntosh's "*Technology of Sugar*"

available per ton of beet are $\frac{16,000}{41{\cdot}6} \times 950 = 365,000$, leaving to be provided by the furnaces $2,160,000 - 365,000 = 1,795,000$. If the furnace has an efficiency of 95 per cent. and the coal used has a calorific value of 13,500 B.Th.U., it would be necessary to burn :—

In the dryer furnaces	140·0 lbs.
In the boilers (10 lbs. evaporation per lb. coal)	38·5 lbs.
Add 63 per cent. for radiation losses	11·5 lbs.
	190 lbs. coal per ton of beet.

= 8500 tons coal for 100,000 tons beet. (8·50 per cent.)

On the basis of the steam consumption shown in Table II (above) the extraction part of the process will require 2230 tons of coal on the same evaporative basis. This makes a consumption of 10,738 tons of coal per annum to which may be added 90 tons for standby losses, making a total of 10,820 tons per annum.

Labour.—Labour for handling, washing and slicing will follow normal practice and has been estimated on that basis, assuming the use of the most economical devices for handling. For drying, labour is employed over one hundred days only and is mainly unskilled, and wages have been taken at the district rate at Eynsham. Allowance has been made for three shifts per day with one foreman, one engine driver and two stokers on each shift in addition to five workmen, making nine men in all. Labour employed on the extraction plant is engaged throughout the whole year. The engine drivers and stokers employed during drying will be employed during the first hundred days' extraction. For the remainder of the year one engine driver and one stoker will be on each shift. The labour employed during extraction is generally of the same semi-skilled character as that needed during drying except in the case of the sugar boilers, who are skilled men and paid at an accordingly higher rate. Extraction will need twenty-four men a shift with an engine driver and stoker common to both drying and extraction over the first 14 weeks. One fitter and mate a shift have been included through the whole year at usual rates. The salaried staff has been estimated on the same basis as a diffusion factory, allowances being made for a reduced clerical and chemical staff working throughout the whole year.

The remainder of the working costs, administration, sundry stores, etc. have followed standard practice, with the exception of insurance of the dried cossettes which is additional. The foregoing calculations for the 100,000 ton factory are applicable also to the 25,000 ton factory, but in the latter case allowance has been made for the reduced economy in the working of a smaller plant.

In a 25,000 ton factory equipped for drying and extraction, the production cost, including all overhead and standing charges, excluding the cost of beet, is estimated to be not more than 19s. 3d. per ton of fresh beet treated. For a 100,000 ton factory the cost is estimated to be not more than 15s. 2d. per ton of fresh beet treated. At an average extraction of 13·25 per cent. of sugar and omitting the cost of fresh beet, one ton of sugar can be produced for about £7 5s. and £5 14s. 5d. respectively. Considerable improvement in the efficiency of labour and staff, which cannot be well expressed in figures, should result from their continuous employment.

APPENDIX II.

	Factories capable of handling per annum 100,000 Tons of Beet. (capital Cost £175,000.)		Factories capable of handling per annum 25,000 Tons of Beet (Capital Cost £60,000.)	
	Total Cost.	Cost per Ton of Beet.	Total Cost.	Cost per Ton of Beet.
Fuel (coal—13,500 B.Th.U. at 26s. 6d. per ton)	14,340	0·1434	3,800	0·1520
Wages and Salaries	22,270	0·2227	7,950	0·3180
Rates, Taxes and Insurance...	4,740	0·0474	2,140	0·0856
Office Expenses	1,300	0·0130		
Consumable stores, bags, Lime and Superphosphates, etc.	14,550	0·1455	3,860	0·1544
Sundries	1,125	0·0112	280	0·0112
Depreciation at 10 per cent.	17,500	0·1750	6,000	0·2400
	75,825	0·7582	24,030	0·9612

i.e., 15s. 2d. per ton of fresh beet worked or £5 14s. 5d. per ton of sugar produced at 13·25 per cent. extraction, exclusive of cost of fresh beet.

i.e., 19s. 3d. per ton of fresh beet worked or £7 5s. 1d. per ton of sugar produced at 13·25 per cent. extraction, exclusive of the cost of fresh beet.

GROWERS' DRYING EQUIPMENT.

It has already been mentioned that the Commission recommended that experiments should be conducted with the aim of designing a complete cleaning and desiccating equipment for operation by the beet grower. The object of an equipment of this kind is to effect a saving in transport. The capacity at which a diffusion factory can operate economically in this country is generally accepted as being not less than 75,000 tons of fresh beet per campaign of 100 days. Under the agricultural conditions at present existing in England, this means the product of about 7000 acres and may involve bringing beet at considerable cost over a distance of 50 miles.

Should the desiccation process be established in this country, it should be possible to introduce a system of drying beet locally. In this way the cost of transport from distant areas to the present diffusion factories or other central factories could be very much reduced and the area under beet might be extended to localities which otherwise would continue to be out of reach of a convenient market. In anticipation of developments on these lines the Institute proposes to experiment further in devising suitable apparatus for cleaning, slicing and drying on the farm. Consideration will also be given to devising some inexpensive means of packing dried beet for various kinds of transport.

According to *Commerce Reports*, it is reported that in the Santa Clara district of Cuba fertilizers have been generally used this season, the first time, it is said, in 300 years.

In place of the stemless glass funnels usually used for filtering in polarization work, copper funnels made in one piece without seam are now being tried, these being supplied with a well-fitting aluminium cover to prevent evaporation. Such unbreakable apparatus is greatly preferred to glass, or even vulcanite, and should be found in every up-to-date sugar laboratory, especially overseas.

Study of the Absorption Spectra of Factory and Refinery Products.[1]

By T. B. WAYNE.
Imperial Sugar Co., Sugar Land, Texas.

PART II.

(*Continued from page* 487.)

SELECTIVE DECOLORIZATION BY CHAR.

The consensus of opinion regarding selective decolorization by char is that the grey colouring matter is more easily removed than the red. This assertion is made in the older treatises on the subject, and was recently confirmed by BARDORF and BALL.[2]

But recognizing the possibility that char may not always exhibit the same kind of selective adsorption on colouring matters found in different kinds of raw sugars, the question was investigated in the following way, using four different liquors having different types of absorption curves.

Four centrifugal raws were washed up to 99° purity, melted to 60° Brix at 17·5 C., limed to *pH* 6·8, and filtered using kieselguhr after heating to 83° C. (181° F.); 260 c.c. of this liquor were heated to 80° C., and char of 12 × 28 grist (washed and burned) added in the proportions of 20, 30, 40 and 60 per cent. of the weight of solids present, the mixtures being heated to 80° C. for 3 hours, while shaking for 15 secs. every 30 mins. Lastly the liquors were filtered bright, and prepared for spectrophotometric analysis.

(*a*) *Green Lousiana raw.*—This sugar represents an extreme seldom found in raw sugars. The absorption ratios are very low in the blue end of the spectrum, and examination shows that much of the original greenish bodies present in the raw cane juice has been boiled directly into the crystals. The affination syrup is green instead of red, and, after purging the sugar free from adhering molasses film by repeated washing in the centrifugals, the washed sugar liquor prepared therefrom is green instead of reddish. The washed sugar liquor had very much the appearance of cane juice, and was filtered with great difficulty. A slight change in temperature caused the liquor to become turbid again owing to the precipitation of slightly soluble matter which is ordinarily removed by lime and heat in the raw sugar factory. Bonechar shows a selective adsorptivity in the red end of the spectrum on sugar liquors of this type. The fact that most of the light-absorbing bodies in this sugar were probably derived from the natural colouring matter of the cane, probably present in a state bordering on the colloidal, explains the ease with which bonechar removes them.

(*b*) *Philippine raw.*—This sugar resembles the previous one in that some of the natural greenish coloured cane products are present. However, its appearance is greyish owing to the presence of a larger proportion of the other types of colouring matter usually found associated with raw sugars. In its action on this liquor, the bonechar appears first to adsorb the readily available colouring matter in the red end of the absorption spectrum, and then as the proportion of char to solids is increased its selectivity for the colouring matters responsible for light absorption in the blue end is more pronounced. We have here the first indication that other light-absorbing bodies possessing maximum absorption in the red end of the spectrum may be present, and that these may be even more resistant to adsorption by char than the decomposition products of the sugars which show maximum light absorption in the blue end of the spectrum. The fact that this liquor first shows an increase in the blue end, accompanied by a decrease in the red end of the absorption spectrum, then a reverse to the opposite condition as the proportion of char to solids is increased, bears out this conclusion.

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[1] Abridged from *Ind. Eng. Chem.*, 1926, 18, 847-848.

[2] "The Elements of Sugar Refining." By C. F. BARDORF and J. A. B. BALL (Chemical Publishing Co.), 1925, page 33.

(*c*) *Average Cuban raw.*—This sugar has an absorption spectrum of average trend, and the washed sugar liquor obtained from it shows an average trend of absorption ratios from the blue to red ends of the spectrum. Treatment with 20 per cent. bonechar likewise removes first the easily adsorbed colouring matter from the red end of the spectrum, yielding a partially decolorized liquor whose absorption spectrum is higher in the blue end and lower in the red end. However, if 40 per cent. char is used, the ratios decrease in the blue end and rise in the red end to the extent that the resulting liquor shows less absorption in the blue and more in the red ends than was the case with the original liquor before char treatment. This same tendency was noted in decolorizing the liquor described under (*b*) but to a smaller extent.

(*d*) *Reddish Cuban raw.*—This sugar has a bright reddish appearance. The grain is large and clear, and purges very cleanly in the centrifugals. The washed sugar liquor prepared from it is bright, and redder than the usual run of raw sugars produced. There is a progressive increase in the absorption ratios in the red end accompanied by a decrease in the opposite end of the spectrum. This liquor was prepared from a raw sugar which had evidently been manufactured from a heavily clarified juice. That is, the precipitation of impurities from the raw juice had been very complete because an excess of lime and heat had been used during the clarification, and the resulting sugar had acquired a reddish appearance. When decolorized by bonechar, the colouring matter causing absorption in the blue end of the spectrum was removed, leaving the light-absorbing bodies showing greater absorption in the opposite end of the spectrum. Since the characteristics of the decomposition products of sugar are not well enough defined and understood to warrant any definite conclusions, it is unknown whether these char-resistant bodies are residual green or grey materials from the raw cane juice which were not removed by the clarification process in the raw sugar factory, or were formed from sugar by the action of lime and heat.

(*e*) *Caramel syrups.*—In the preceding studies of the decolorization of four general classes of centrifugal washed raw sugars, it was indicated that bonechar has a very great selectivity for the greenish bodies sometimes found in raw sugars as the result of imperfect clarification in the raw sugar factory. These materials, possibly entirely organic, are likely to be present in a semi-colloidal state, and hence yield readily to the action of bonechar. Next in ease of removal are the bodies causing maximum absorption in the blue end of the spectrum, the physical equivalent of which to the eye is a red colour. Finally, as complete decolorization is approached, the curve of the absorption spectrum again tends to straighten out by an increase in the red end and a decrease in the blue end.

Since this phenomenon was noted even in the case of red liquors, a caramel syrup was prepared by overheating a quantity of sucrose syrup until some caramel had formed. The syrup so prepared was adjusted to 60° Brix at 17·5° C. and after analysing spectrophotometrically, 260 c.c. portions were treated in the usual manner with 20, 30, 40, and 60 per cent.

char on the solids content. The selective action of bonechar reverses from the blue to the red end of the spectrum in caramel solutions of this type. It appears that the degree to which the caramelization is carried determines its resistance to decolorization. In one instance where the caramelization was fairly complete, resulting in a caramel which showed less absorption in the blue end of the spectrum than in the present instance, bonechar selectively removed colouring matter from the blue end, while the caramel showing the highest absorption in the blue end is selectively decolorized in the red end of its absorption spectrum.

(*f*) *Granulated syrup.*—Granulated syrups are the syrups obtained from strikes of granulated sugar massecuite after drying in the factory centrifugals. Under the usual system of boiling, the highly filtered liquors of 99·5 purity are boiled to strikes of granulated sugar and the wash therefrom is taken back into the pans and used in boiling other strikes of granulated sugar. After a time the syrups have dropped in purity and their colour has risen to the point where further char filtration is required. Syrups of this type are relatively hard to decolorize, as their colour is made up of concentrated colouring matter from that originally present in the high-grade liquors, together with some caramel formed by heat.

Owing to the small amount of colouring matter present in granulated syrups, it was not possible to make complete spectrophotometric analyses of the decolorized liquors from the 20, 40, and 60 per cent. char treatments. Therefore, arrangements were made to secure samples of unfiltered and once-filtered granulated syrups from the refinery.

Bonechar selectively removes the colouring matter from granulated syrups which show maximum absorption in the blue end of the spectrum. This has been proved by previous work by the laboratory of the Imperial Sugar Company. The residual colour in double-filtered granulated syrups is characterized by high absorption in the red end of the spectrum; those coloured bodies which excite the physical sensations of red and yellow are selectively removed by char because of the higher resistance of the greenish substances. Since the greenish or greyish substances present in these syrups are mainly residues from the colouring matter remaining after repeated char filtration of high-purity liquors, they are naturally more resistant to adsorption by char than the caramel formed by heat in neutral solutions of sugar. In the decolorization of various types of centrifugal raw sugars, it has been shown that the grey or green colouring matter derived from the cane is most easily removed by char; so that the residual colour of this type remaining after the many char filtrations that these high-purity liquors receive is either derived from the action of heat or may be an extremely char-resistant substance present in small quantities in the original raw sugar.

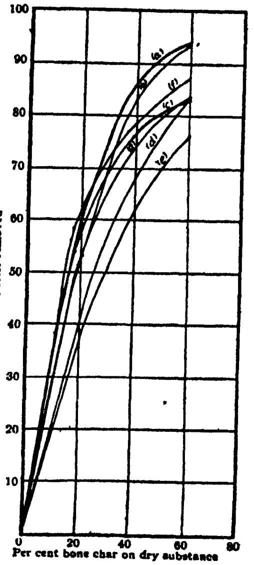
Low-purity wash syrups.—Under this heading come the affination syrups removed from the crystals of raw sugar by the affining process and the wash syrups from the various high and low remelt and soft sugar strikes. The lower purity wash syrups are char-filtered for use as barrel syrups, while affination syrups are usually char-filtered over two or more grades of char in order that a certain amount of off-grade granulated sugar may be obtained before boiling them to remelt.

Decolorization of low-purity syrups is more difficult than in the case of high-purity washed sugar liquors. Since in refinery practice these syrups are filtered after the char has been used for filtration of higher purity liquors, they seldom come into contact with highly active fresh char. Decolorization studies on this class of syrups will not be presented in detail, but in general char will first remove colouring matter showing highest light absorption in the red end of the spectrum and cause the absorption ratios to increase in the blue end. In the case of affination syrups, however, if the filtration is carried to the point where additional char does not effect a marked reduction in colour, spectrophotometric analysis reveals that this residual colour is quite similar to that found after extensive filtration of granulated syrups. Barrel syrups, however, invariably show an increase in absorption ratios at the blue end as the decolorization proceeds. Owing to the high original colour in this class of syrup, and the relatively inactive grade of char used in filtering them, decolorization never reaches the point where the trend of absorption ratios reverses.

DECOLORIZING STUDIES.

Per cent. decolorization on each type of liquor and syrup, with 20, 30, 40, and 60 per cent. char on solids content at 60° Brix, was determined in the course of the experiments used in establishing the absorption ratios. While the presentation of adsorption curves is not the primary object of this paper, fairly accurate curves may be plotted from the values determined at these four points, as shown in the graph.

These curves reveal some interesting facts. The greenish appearing Louisiana raw sugar (*a*) shows a steep curve up to 86 per cent. decolorization by 40 per cent. char, but the curve straightens out considerably between 40 and 60 per cent. char. The easily removed organic non-sugars derived from the cane are probably exhausted near this point, and the char meets more highly resistant colouring matter. Since it is this residual colouring matter which appears in the high-purity liquors from which granulated sugar is boiled, if decolorization cannot be increased much above 94 per cent., this sugar may not be so desirable from the refiners' standpoint as might be inferred by comparison with the decolorizing curves of some of the other sugars. The colour value of 0·015 attained with 60 per cent. char is far from satisfactory for the manufacture of high-grade granulated sugar, and should the decolorization curve straighten out from this point on, the apparently high decolorization at this point may be misleading.



The same may apply to the grey-green Philippine raw sugar (*b*). The Cuban raw sugar (*c*) of average trend, or possibly somewhat greyer than the average raw sugar, falls off considerably as decolorization becomes more complete. The reddish Cuban raw sugar (*d*) shows less decolorization at all points than the other raw sugars, but there is no sharp decline in the curve. Had decolorization been carried to the point necessary for the production of high-grade granulated sugar, the colour of this liquor might have been less than the other sugars, when larger percentages of char were used. Good refinery practice calls for nearly 100 lbs. of char per 100 lbs. of sugar melted, so had the decolorization curve for this sugar been extended to this point it might perhaps have crossed some of those for other sugars which showed higher initial decolorization with smaller percentages of char. All of this merely emphasizes the complexity of the mechanics and reactions of decolorization, and illustrates how far from correct empirical decolorization tests may be if the conditions under which they are made vary from the industrial conditions under which the carbon will be used.

There is similarity between the curves for the caramel-sucrose solution (*e*) and the granulated syrup (*g*). No doubt the red colouring matter present in the granulated syrup is caramel having a similar curve of absorption ratios, since any caramelization in such a syrup must be of very incipient nature. However, on the other hand, the fact that the total colour present in the caramel syrup is nearly seven times as great as that present in the granulated syrup renders it difficult to explain why the curve for the granulated syrup is lower at all points. This may mean that colouring matter in the granulated syrup is made up of the residual green or grey matter left after extensive char filtration plus a small quantity of caramel having a very high light absorption in the blue end of the spectrum. The mixture of these opposite types of colouring matter, when read at the different points in the visible spectrum, gives a curve of absorption ratios similar to that which may be plotted from the values determined for the granulated syrup.

The Farrel "Mill-Shredder."

Our readers will by now be familiar with the cane preparatory device known as the Crusher-Shredder,[1] patented by Dr. MAXWELL, which consists of a crusher provided with a shredder roll that co-acts with the top roll of the crusher pair, and results in two processes of crushing and shredding being performed by one unit.

A variation of the design is, however, being installed at Central Espana, Cuba, by the Farrel Foundry & Machine Company (the manufacturers in the U.S.A. of the Maxwell patents) to which they are giving the name of "mill-shredder." This mill is based fundamentally upon the same principle, but whereas the Crusher-Shredder is the name given by the inventor to a design of entirely new construction, a "mill-shredder" proposes to describe the result of converting an existing mill to the crusher-shredder principle. It is in fact a common three-roll mill, of which the bagasse or discharge roller is replaced by a patent Maxwell shredder roll. On these lines any existing mill, according to the Ansonia firm, can be easily altered into a combined crushing or milling and shredding device without necessitating any alterations to the existing plant whatsoever; the bagasse roller is simply removed and the shredder roller together with its bearings substituted in place. This shredder roll is driven independently by electric motor, turbine or steam engine, as circumstances dictate. An advantage of this alteration is that it can be carried out in a very short time and, if need be, during an actual crop grinding.

This Cuban mill-shredder will be of the dimensions of 36 in. by 84 in., which represents the largest size of milling unit commonly in use in the West Indies. And in addition to this unit, Messrs. Farrel are installing a Maxwell Crusher-Shredder at Central San Francisco, Porto Rico. Both machines are to begin operations in the coming 1927 season.

According to the *African Sugar and Cotton Planter*, the Darnall mill, Natal, one of the Hulett group of sugar factories, has put up a record achievement for that country, it having handled within 140 hours no less than 10,005 tons of cane and from this manufactured 1140 tons of sugar. The ratio of cane per ton of sugar was 8·76, while the crushing efficiency was 98 per cent.

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[1] *I.S.J.*, 1923, 499; 1925, 418.

The Production of Sugar in Germany during the 1925-1926 Campaign.

From official figures just published it can be seen that the total production of sugar (valued as raw) in Germany during the period from September 1st, 1925, to August 31st, 1926, has not changed in any notable degree. It amounted to 16,059,598 double centners[1] compared to 15,636,404 double centners in the campaign of 1924-1925.

The quantities of beets and raw sugar consumed in the respective periods by the raw sugar manufacturers and refiners is shown in the following table :

Sept 1st to Aug 31st	CONSUMPTION OF Beetroots	Raw Sugar in double centners.	Own Sugar
I. By Raw Sugar Factories :—			
1925-1926	102,481,546	2,637,016	27,552
1924-1925	97,660,898	2,616,997	25,402
II. By Refiners :—			
1925-1926	—	8,635,533	136,286
1924-1925	—	8,614,374	156,110

The sugar for consumption produced from the above during the two last campaigns was the following :—

	Crystalized Sugar.	Granulated Sugar	Cube, etc, Sugar. (In double centners.)	Refined Powder Sugar.	Powdered Molasses Sugar	Other kinds.
I. By Raw Sugar Factories .—						
1925-26	3,586,923	317,347	402,099	928,603	936,449	61,377
1924-25	3,776,034	334,310	311,825	841,851	896,977	67,571
Total : 1925-26 : 6,232,798						
1924-25 : 6,228,568						
II. By Refiners :—						
1925-26	2,256,547	1,579,890	798,776	1,199,837	1,709,816	500,966
1924-25	1,823,484	1,986,143	710,670	1,229,214	1,831,876	427,181
Total : 1925-26 : 8,045,832						
1924-25 : 8,008,568						

To the above figures must be added the quantities of sugar with a purity as low as 70 per cent. and less, obtained in the manufacturing process, and which amounted to the following :—

	I. At Raw Sugar Factories	*II. At Refiners*
1925-26	2,757,067	925,023
1924-25	2,451,083	977,433

The consumption of beets at " raperies " for the manufacture of sugar juice only has been as follows, in double centners.

	95 and more per cent	70-95 per cent	Less than 70 per cent
1925-1926 : 583,053, yielding juice with a purity of	202	114,251	361
1924-1925 : 275,685, „ „ „ „ „ „	64	49,048	5,972

The extraction in these "raperies" of juice from the beet for transfer to sugar factories proper, as stated in a previous report, has made considerable progress during the last campaign, because of the desirability to reduce as much as possible the cost of production, and particularly to save in transportation.

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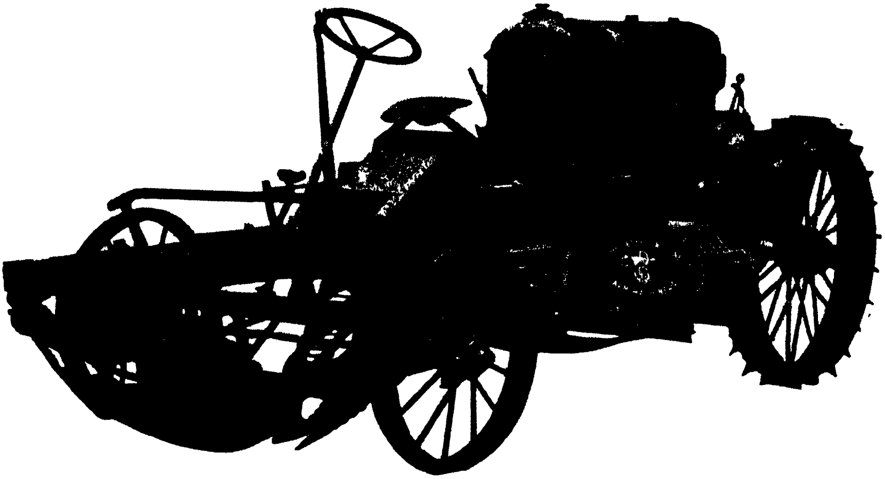
[1] One Double Centner = one-tenth of a metric ton.

The "Greyhound" Beet Harvester.

A demonstration was given at Crowland, near Peterborough, on August 25th, of this apparatus, which has already been noticed,[1] and the company of experts who carefully examined the claims of Messrs. STANHAY, LTD., of Ashford, Kent, (who are agents for the American manufacturers) appear to have been favourably impressed.

This beet harvester is stated to top, lift, clean, and to reap better than by hand, and at less than one-sixth the cost. Our representative was informed that the running costs of working amount to 5 to 12s. per acre, compared with anything from £2 to £5 per acre, as now paid for the same result by the farmer in this country. It was said to be capable of lifting 3 acres per day of 8 hours. Aside from the frame-work and power transmission unit, the harvesting mechanism consists of two elements, the topping and digging devices :—

The topping unit consists essentially of a power-driven tread belt which travels over the tops of the sugar beet and holds them firmly, and a power-driven revolving bell disc cutting unit which cuts off the tops of the beet and throws them in a line to the side of the machine. The cutting disc is so accurately gauged by the travelling tread belt that the larger the beet the greater the cut made from it, though only the acid crown is removed. Therefore the revenue-producing part is preserved to the greatest extent.



The lifting unit consists of two outwardly revolving augers, power-driven, in front of which are two lifter points which act in conjunction with the augers to lift the beet out of the ground. Above the augers is a travelling chain belt which holds the beet in the augers as they are conveyed to the hopper. The revolution of the augers cleans the beet. This remarkable device lifts every beet in the row out of the ground, cleans it thoroughly and transfers it to the hopper at the rear of the augers, to be unloaded at wish by pressing down a foot lever placed in front of the driver's seat. These two work on the same row, i.e., topper and lifter.

The harvester can be readily adjusted to work in rows of 18 to 24 ins. apart. The rear wheels are fitted with road bands so that the machine can travel on the road. Total weight of the machine is two tons and the cost £595. The Fordson tractor which supplies the motive power is detachable in 20 mins., and the whole of the machine is thus not out of use during the period of the year when it is not harvesting beet.

A recent patent utilizes the gases produced in lime burning for generating electricity, at a cost (it is claimed) considerably lower than that possible with coal or oil. This process can be applied to any plant without alteration, the inventor's generator being fitted in place of an ordinary one.

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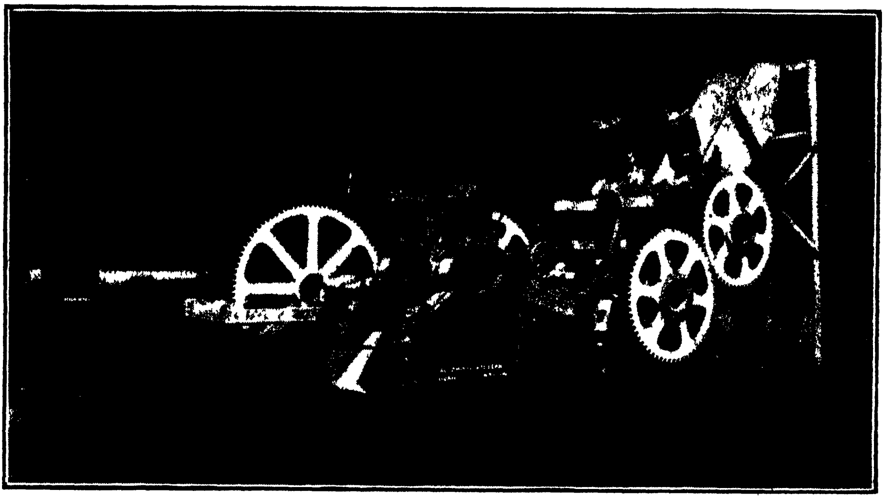
[1] *I.S.J.*, 1926, 438.

Efficient Cane Mills of Small Calibre.

We learn that Messrs. Blair, Campbell & McLean, Ltd., of Glasgow, have recently been executing some orders for some small cane mills of really high-class construction, generally similar in design to their large units, and much superior to the usual type of small mill hitherto generally in demand. In these new types the plant, as the illustration shows, consists of an 8-roller set preceded by a Krajewski crusher. The rollers are all 16 in. diam. by 24 in. long. Krajewskis are not usually considered to be suitable for small mills, but in this case special care has been taken in the design of the grooving to ensure good results.

Although small, this mill is of very heavy construction throughout. All journals are 7 in. in diam. by 9 in. long. Spring pressure gear of the plunger type is provided for both the crusher and the two mills, and all the springs are interchangeable; the crusher is provided with 8 springs, giving a normal pressure of about 50 tons and a maximum of 80 tons; and each mill with ten springs giving a normal pressure of about 65 tons and a maximum of 90 tons. The crusher headstocks are mounted on separate girders, and wedge adjustment is provided between the bearings. The mills have top roller flanges; inclined king bolts, allowing narrow trash knives; adjustable trash bars with renewable knives; screw adjustment to the side rollers; and other special features not normally incorporated in such small plants. The gearing is of heavy design, and the first motion wheels have machine cut teeth, while the second ones are machine-moulded; all the gear wheels and pinions are from steel castings. The driving engine has a cylinder 12 in. in diam., by 24 in. stroke, and runs at about 90 revs. per min. It is provided with a hand reversing gear, mechanical cylinder lubricator, and all the usual accessories.



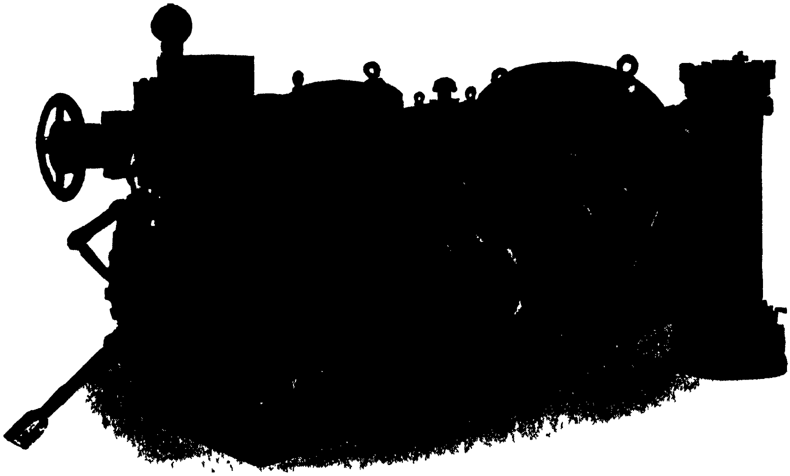
This plant is destined to deal with cane of approximately 11 per cent. fibre, and is expected to crush over 4 tons of cane per hour, and to extract 87 per cent. of the sucrose from the cane. Incidentally, the makers are shipping another milling plant to the same district which is an exact duplicate of the one illustrated above, except that the crusher is of the "Splitter" type instead of being a Krajewski. Since the two plants are going to neighbouring estates, and will work on similar cane under similar conditions, the results should show clearly the relative advantages of the two types of crushers in these small sizes of mills.

The late J. W. Macdonald, Vice-Chairman of Tate & Lyle, Ltd., Refiners, London, left estate to the gross value of £210,419.

Turbo Generators for British Beet Sugar Factories.

Messrs. G. & J. Weir, Ltd., of Cathcart, Glasgow, are completing an order received from Messrs. Duncan Stewart & Co., Ltd., London Road Iron Works, Glasgow, on behalf of the Second Anglo-Scottish Beet Sugar Corporation, Ltd., to supply to each of the latter company's three beet sugar factories—at Cupar, Fife. Felstead, Essex; and York—two turbine-driven generating sets. One set is for working, and the other to act as a stand-by in each factory. One of these is illustrated herewith.

The turbines are of the " Impulse " type, having one pressure and two velocity stages, and are run at a speed of 4,000 revs. per min. The pressure of the steam supply to the turbines varies between 200 and 150 lbs. per sq. in. with superheat of 80°F. These turbines exhaust against a back pressure of 15 lbs. per sq. in. above atmosphere. The casings are of cast-iron with steam and exhaust branches on the bottom halves. The rotor, fixed blades, and shrouding are made of Monel Metal, so as to resist the destructive action of ammonia, which is present in the steam. The shafts are of chrome nickel steel. The bearings are of the pedestal type, lined with white metal and provided with adequate ring lubricators. The governor bearing pedestals also contain a Michell thrust bearing and reduction gear for the governor drive.



Each turbine is fitted with a 7 in. cast-iron steam stop valve, which has Monel Metal fittings and is controlled and operated through the usual trip-gear, by the emergency governor on the turbine shaft. The steam throttle valve casing contains a steam strainer, and a double seated balanced steam throttle valve, operated by the speed governor through an oil relay. The governor and relay maintain the permanent speed of the turbine within plus or minus quarter per cent. from no load to full load. The turbine is coupled direct to the high speed shaft of suitable reduction gears; the gear casing is split horizontally, and is of heavy design, so as to prevent vibration. The bearings supporting both the pinion and wheel shafts are of the Michell patent journal type. The slow speed shaft is arranged to support half the weight of the generator armature, and runs at a speed of 1000 revs. per min.

As will be seen from the illustration, each set is provided with an oil cooler having a suitable pump, strainer, and everything necessary to supply oil to the reducing gear, the turbine bearings, and the governor.

The steam turbine and gear casing are mounted on one cast-iron bedplate. The alternator and exciter are mounted separately, and the two bedplates are provided with flanges and bolted together so as to form one compact unit.

The alternator, it may be added, was supplied by the English Electric Coy., Ltd. It is capable of developing 600 K.W.

The Cuban 1925-26 Sugar Crop.

The Final Figures of Output.

Messrs. Guma & Mejer have just issued their final tabulation of the Cuban 1925-26 sugar crop, the summary by provinces being as below. The six largest outputs were from factories in Oriente and Camaguey provinces, and were as follows : Morón, 109,812 tons ; Vertientes, 107,015 tons ; Delicias, 100.315 tons ; Manati, 95,821 tons ; Stewart, 77,660 tons ; Jaronú, 77,174 tons (all of 2240 lbs.).

		Sacks[1]	
Provinces	Centrals.	Total.	Estimate
Pinar del Rio	10	1,190,859	1,500,000
Havana	16	2,530,406	2,895,000
Matanzas	27	3,755,903	4,305,000
Santa Clara	53	6,714,078	7,285,000
Camaguey	29	10,265,408	11,210,000
Oriente	42	9,735,953	10,421,000
	177	34,192,607	37,616,000
Tons		4,884,658	5,373,714

The Bank of London and South America monthly *Review* reports that at the end of June the grinding of this season's crop of cane in Tucuman was in full swing and everything pointed to a good harvest. The low trend of prices has, however, depressed the sugar markets in Argentina, and the outlook is far from promising. Attempts have been made to get the railways to reduce their freight charges for carriage of sugar from Tucuman to the coast.

Victoria Nyanza Sugar Co., Ltd., at their fourth annual meeting at Melbourne reported that in 1924-25 the company ground 20,073 tons of cane, turning out 1385 tons of white sugar. New areas are being prepared for planting, and Mr. G. R. Mayers said that he had confidence that under careful management the Company would gradually develop into a sound investment. Operations showed a profit of £10,000 after writing off £6000 for depreciation.

The formation of The Sugar Technologists' Association of India, with Mr. Noël Deerr as President and Dr. E. R. Watson as Vice-President, is announced. Mr. K. C. Banerji, Ghughli P. O., District Gorakhpur, is Secretary, and Mr. Lala Kesay Ram Narang, Treasurer. Members of the Council include Dr. John Haldane, Messrs. A. Brookes, R. C. Srivastava, H. N. Batham, and M. N. Chatterji and Raj Sahib S. C. Banerji. It is expected that most of the modern factories in India will support the Association, the first meeting of which will be held in November.

Dr. Ralph Pemberton, of Philadelphia, lecturing before the American Medical Association, at Dallas, Texas, on diseases of the bones and joints,[2] said that in more than 60 persons suffering from such ailments he had found a low tolerance of sugar. He had established experimentally that sugar taken by the mouth passes by way of the blood to the fluid of the joints, and there is good evidence that it aids their resistance to disease.

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[1] Of 320 lbs.

[2] *Western Irrigation*, July, 1926.

Brevities.

The Australian National Power Alcohol Co., a concern with a capital of one million pounds, in which the Distillers Co., Ltd., of Edinburgh, is stated to be interested, plans to erect plants at Cairns and Townsville and to take over the Plane Creek Co.'s factory. Cairns will have a capacity of 1,000,000 gallons of spirit per annum.[1]

According to the U.S. Dept. of Agriculture Weather Bureau, the rainfall of 1925 in the West Indies was generally well distributed but was mostly light to moderate in amount. The greatest deficiency was experienced in Porto Rico, the Virgin Islands, and Jamaica. the last mentioned island being 20 per cent. below the normal. Cuba had a rainfall of 47.80 ins., her average over 20 years being 54.99

A mill manufactured by the Farrel Foundry & Machine Company, Ansonia. Conn., is reported to have made a world record in crushing cane. Central Consuelo of the Cuban Dominion Sugar Corp. at San Pedro de Macoris. Dominican Republic, has recently finished grinding the 1925-1926 crop, with a record of 702,847 tons or 56,227,760 arrobas of cane. This record was made with a Farrel 36 in. × 84 in 18-roller mill and single crusher. From this vast amount of cane 468,034 bags of sugar were produced.

Messrs. Ransomes, Sims & Jefferies, Ltd., of Ipswich, in their annual report for the year ending last March were able to show a substantial improvement in their general trade, both at home and abroad. The net profit was £87,969, as compared with £60,625 in the previous year; but in view of the losses now being incurred through the coal strike a dividend of only 5 per cent. was decided on, £25,000 being placed to special reserve to meet those losses, and a like sum going to general reserve. The latter item now stands at £125,000, on an ordinary capital of £500,000.

In a lecture given before the Royal Society of Arts[2] on "Thermometry," Mr. W. F. Higgins mentioned that the acceptance of the melting point of ice and the boiling point of water as the two fixed points and the division of the temperature interval between these two points into 100 equal parts is due to the suggestion of Celsius of Upsala in 1742, but it is of importance to note that he denoted the freezing point by 100 and the boiling point by 0. Inversion of this procedure was proposed by Stormer, a colleague of Celsius, a few years later, while the suggestion had also been put forward independently by Christin of Lyons in 1743.

Under the title of "The Sugar Bowl Series," the Great Western Sugar Co of Denver, Colo., is issuing attractive booklets on the domestic use of sugar, the recipes being by Mrs. Ida Bailey Allen, an American authority on cooking. Vol. I is on "Canning, Preserving and Jelly Making"; Vol. II contains 75 Desserts; and Vol. III is entitled "Candy Making, the Easy Way." G W. beet sugar is said to have been used in the preparation of all these recipes, and is described as a "superior sweetener, uniformly the purest, highest quality that can be obtained," "guaranteed for canning, preserving and jelly making," and of standards of purity "unexcelled in any other sugar." Some of the quotations from these booklets are as follows: "Sugar properly refined is perhaps the purest foodstuff from a chemical standpoint used in the kitchen . . . . . Great Western Beet Sugar . . . . has a uniform purity of 99.9 per cent. . . . . . . The overwhelming testimony of housewives, chemists and domestic science experts supports the merit of pure beet sugar in comparison with that from any other source . . . . . Many of the candy makers here and abroad feel they can make candy only with beet sugar. They say that hard candies made with it do not stick together, that it does not seem to need such hard boiling, and the Great Western beet sugar is so pure that candies made with it are of superior colour."

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[1] *Ind. Aust*, July 15th, 1926.

[2] *The Royal Society of Arts Jl.*, 1926, **24**, No. 3850, 946-959.

Review of Current Technical Literature.[1]

A NEW THEORY OF MOLASSES FORMATION. **Jar. Dedek and Peter Terechov.** *Zeitsch. Zuckerind. Oechoslov.*, 1926, **50**, No. 42, 349-355.

Since every theory of the chemical formation of molasses assumes a reaction between sucrose and non-sugars (especially the salts), it would appear very likely that in most of these the sucrose must play the part of an acid. Since the consideration of sucrose as an acid is of much interest in this connexion, the influence of sodium and of calcium hydroxides on sucrose was studied by the authors in aqueous solution. Hydroxyl-ion concentration measurements by means of a potentiometer (Poggendorf's compensation apparatus, using normal hydrogen and calomel electrodes) were made, as well as molecular weight determinations by the cryoscopic or depression of freezing point method. It was deduced from these experiments (details of which may be omitted here) that, in respect of dilute solutions (up to N/1 concentration) of the bases employed, sucrose behaves as if it were a monobasic acid (forming, for example, calcium monosaccharate), whilst at higher concentrations the valency rises, being controlled merely by the ratio of sucrose to alkali. These results were confirmed also in a general way by the figures obtained in the determinations of the depression of the freezing point. Turning now to consider molasses, naturally the extent to which the sucrose participates in such reactions with the salts present depends on the ratios of sucrose to salt-ions in conformity with the Guldberg-Waage law of mass action, and with the dissociation constants of the salts of the corresponding anions. Generally speaking, the stronger the concentration of the salts, and the weaker their acids, then the greater the amount of sucrose entering into the reaction; in other words, the smaller the amount of free sucrose left in solution. In order to obtain further evidence of the degree to which this ratio exists in technical molasses, its composition in equivalent concentrations was calculated, whereby the authors come to the particularly interesting conclusion that in the same molasses the molar concentration of the sucrose practically agrees with the equivalent concentration of the K′ and the Na′. As an example, they take a table in Dr. Wohryzek's book,[2] calculating that on the average the sucrose concentration amounts to 0·183 mol. per 100 of dry substance, whilst the equivalent concentration of the K_2O is 0·141, and of Na_2O, 0·034, that is, 0·175 together, whilst if the CaO (0·005) and the MgO (0·005) were both considered, this amounts to the figure of 0·185, a very close agreement in this instance. Accord, even with tolerably significant differences in the above values found on calculation of many analyses stated in the literature of the composition of molasses is so far-reaching as entirely to preclude the possibility of chance in the matter. Indeed, it demonstrates clearly that the relationship discovered rests on a stoichiometric basis.

DANGER OF INVERSION WITH SULPHUROUS ACID IN SUGAR MANUFACTURE. **L. van der Heide.** *Dissertation published by H. J. Paris, Amsterdam,* 1926. *pages* 1-98.

This is an able dissertation (in Dutch) by a chemist, who has closely studied the question of inversion by sulphurous acid in cane and beet sugar manufacture, more particularly in the former industry. *Inter alia,* he points out that if in Java the second carbonation juice, the alkalinity of which has been reduced as low as possible by carbon dioxide (that is, to about 0.01 per cent.), were sent to the evaporators in this condition, colour formation would occur. It is therefore sulphited. Very little SO_2 is required in theory, but it was soon found in practice that more could be taken up by the juice than was required merely for the conversion of the carbonates into the corresponding sulphites; and that, on continuing the sulphitation, the actual degree of acidity did not rise considerably. Compounds were therefore present acting as buffers, i.e., salts of very weak organic acids, set free by the sulphur dioxide. It is consequently possible in the "thin-juice" sulphitation

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] OSCAR WOHRYZEK: "Chemie der Zuckerindustrie" (Julius Springer, Berlin) 1914. Page 530; table 130.

process in Java to reach an end-point at which the juice is acid owing to free organic acids, which do not cause inversion, while no occasion is given for any glucose decomposition. Formerly some uncertainty arose in regard to the establishment of the optimum point, but this doubt disappeared when a system of control for measuring the hydrogen ion concentration was instituted. Dr. VAN DER HEIDE gives an account here of his study of the dissociation constants of the weak acids in cane juice, and incidentally points out the very weak buffering effect of lactic acid salts (which occur in relatively considerable amount in Java carbonation juices).[1] It appears from tests here described that in sulphitation one may proceed to a *pH* less than 7 only if sufficient buffer salts are present; and, when this is so, one may work somewhat below without danger of inversion or corrosion. If, on the other hand, the buffer salts are present in insufficient amount, then there is always danger, and in this connexion it is of some interest to note that this writer actually advises that buffers should be added to the juice in the factory, calcium acetate, for example, being advised. Taken as a whole, this is quite an important contribution to the literature of inversion in sugar manufacture; and, considered as a dissertation, it contains a good amount of useful original and practical data.

DETERMINATION OF REDUCING SUGARS USING INTERNAL INDICATORS. **L. Eynon and J. H. Lane.** *Chemistry and Industry*, 1926, 45, No. 31, 545.

Referring to Mann's attempt to use Dianol Green as internal indicator of unreduced copper in the Fehling's test,[2] these authors point out that under the conditions recommended by this writer the results must be unreliable. MANN specifies the use of 4 drops of a 4 per cent. solution of the dye, that is about 0·01 grm., a quantity which oxidizes an appreciable quantity of sugar. For instance, in the titration of a 0·2 per cent. solution of invert sugar against 10 c.c. of Fehling's solution under their standard conditions[3] EYNON and LANE have found that with the above mentioned quantity of Dianol Green as indicator, 0.7 c.c. more sugar solution was required than with the usual quantity of methylene blue. This of course is not an obstacle to the use of Dianol Green, provided that specially standardized tables are used where high accuracy is required. They find, however, in agreement with some other chemists who have experimented with Dianol Green, that it does not give so striking and sharp an end-point as methylene blue, which yields a colourless reduction product so that the end point is very distinctly shown by the appearance of the bright orange colour of the cuprous oxide, as bright as if no indicator had been added. Dianol Green on the other hand, yields a dark red reduction product which strongly darkens the reaction liquid and renders the end-point much less distinct than that given by methylene blue. The readiness with which methylene blue undergoes back-oxidation in presence of air seems generally to be regarded as a disadvantage, but it serves a useful purpose by giving warning of conditions under which back-oxidation of the Fehling's solution itself may occur. Anyone who has had experience of the ferrocyanide indicator knows how readily such back-oxidation of Fehling's solution takes place. It has been the chief source of error in those volumetric methods in which boiling of the reaction liquid has to be interrupted for external indicator tests. That is why, in the EYNON and LANE standard method, it is proposed to maintain uninterrupted ebullition throughout the titration, the reaction flask remaining stationary on a wire gauze. Under these conditions no difficulty is experienced from back-oxidation either of the Fehling's solution or of the methylene blue. In a volumetric method in which Fehling's solution is titrated to exhaustion, the risk of back-oxidation seems to make water-bath heating unsuitable for accurate work. There is no continuous evolution of steam to sweep out air from the flask, and since the reaction liquid must be swirled round after every addition of sugar solution (actually this is unnecessary as ebullition effects the requisite mixing) the conditions are very favourable to back-oxidation, though this of course would not be shown by a non-reversible indicator such as Dianol Green. It is hardly necessary to point out that under the conditions of working indicated by Mann, the Eynon and Lane tables do not apply. Apart from back-oxidation and the consumption of sugar by the indicator, there will be a difference in the ratio of reducing sugar to copper reduced on account of the difference in temperature of the reaction liquid in water-bath heating as compared with ebullition, the difference being such as to correspond to a difference of more than 10 per cent. of the amount of sugar determined if the same factor were used in both cases.

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[1] Lactic acid is formed from glucose by the action of alkalis.

[2] *I.S.J.*, 1926, 221. [3] *I.S.J.*, 1923, 143, 305; 1924, 107, 161; 1925, 332.

A SIMPLE METHOD FOR THE MEASUREMENT OF THE HYDROGEN-ION CONCENTRATION, AND THE SIGNIFICANCE OF THE H.I.C. IN THE BEET SUGAR INDUSTRY. **F. Tödt.**[1] *Zeitsch. Ver. deut. Zuckerind.*, 1926, No. 838, 494-508.

This paper is mostly a review of work done elsewhere than in Germany, where H.I.C. methods are only now being introduced. It is mentioned that test-papers prepared from indicators of the H.I.C. give only rough approximations suitable for rapid orientations, i.e., for showing whether juice is under or over saturated. But by means of the colorimetric dropping or spotting plate method results accurate to *pH* 0·2 to 0·3 can be quickly obtained by laboratory assistants, a specially printed colour chart[1] claimed very closely to match the shades obtained in practice being used as the means of standardization, in place of buffer solutions, which are said to be "little stable."[2] All the six indicators recommended, which have a range from *pH* 3·0 to 9·6 (namely, brom thymol blue, methyl red, brom cresol-purple brom thymol blue, cresol red, and thymol blue) are used in the form of 0·04 per cent. alcoholic solutions, and it is advised that a separate spotting plate should be reserved for each. Molasses is diluted to 10° Brix; juices of 80 to 90 purity to 20° Brix, and products of higher purity to 30 to 40° Brix, before mixing with the suitable amount of indicator, and treated in the known manner. In some comments on the value of "universal" indicators, it is mentioned that all which contain as the alkaline constituent brom thymol blue are unsuitable for sugar-factory products. Even Merck's mixture when applied to strongly alkaline juice having an actual *pH* of 8·5 gave instead of a blue a green coloration, corresponding to a *pH* of 7·5, being therefore in error to the extent of a whole unit. In the rest of this article dealing with the significance of H.I.C. in the beet sugar industry, it is pointed out *inter alia* when reviewing other work on the subject that first carbonation juices contain strong bases and salts of very weak acids and very weak bases; in second carbonation juice the strong bases have disappeared for the greater part; while in the thick-juice the very weak bases are no longer to be found, having disappeared during the evaporation. Juice from damaged roots show a low *pH*, there being present stronger acids and weaker bases, compared with juice from normal beets, an important observation, since by the collection of experimental results it may perhaps be possible by the *pH* value to judge of the quality of a juice, and in consequence avert or at least ameliorate irregularities in diffusion, heating and the like.

SOME APPLICATIONS OF ELECTRICAL ASH ANALYSIS IN FACTORY AND REFINERY CONTROL. **Harald Lunden.**[3] *Zeitschrift des Vereins der deutschen Zuckerindustrie,* 1926, No. 838, 510-516.

If in calculating the affination yield by means of the formulae of Hulla-Suchomel and others, the ash quotients (polarization/ash) be used instead of the polarization and dry substance or Brix, results simpler and more exact are obtained, and by means of the electrical method conductivity the ash can be found with the same relative accuracy for impure as for fairly pure products. In any case, ash values afford a valuable means of confirmation of the ordinary purity quotient in controlling the extent of the exhaustion of the molasses. Since the modern method of rapidly determining the ash by the electrical method permits of its measurement in quite pure products, it is possible by this means to gauge the quality of grades of finished white goods, as the finest refined, having 0·001 per cent. of ash; average refined, 0·002 to 0·003 per cent.; melis I, 0·005 to 0·008 per cent.; melis II, 0·025; and white sugar, 0·025 per cent. which ash values may be found by the new method with an accuracy of about 1/3 unit of the last decimal place stated. Then it is of importance to note that there is a definite relationship between the ash in the finished product and that in the original massecuite, this being about 1/80, which law has been deduced from the behaviour of various products of the refinery and also in a few raw sugar factories (beet). It therefore follows that for making the five products mentioned above, so that they shall have the ash contents there stated, their massecuites may have an ash content about 80 times greater, namely 0·08, 0·16 0·24, 0·40 0·64, 2·00 and 2·00 respectively. In the raw beet factory using a thick-juice having an ash content of 2 the best product one can expect will thus have an ash content of 0·025 per cent., equivalent to melis II. When dealing with syrups of lower purity having an ash quotient of 5 and more, and an apparent purity of 85 and less, the effect of recrystallization is smaller, namely only 1/50. As to colour, the effect is only 1/25, though in some raw (beet) sugars a persistent impurity has been found, which hinders crystallization, and appears to be responsible for a bad taste, the purifying effect of crystallization on this substance being only from 1/5 to 1/2, which observation leads this writer to remark that "this again shows the impossibility of making a refined sugar which is faultless in respect of taste from the thick-juice of the raw (beet) factory directly without re-boiling." Lastly it has been found that by determining the electrical conductivity at a high density, say over 50° Brix, one can distinguish sharply between products of the refinery end, the refinery raw end (affination syrups), and the raw factory end. Syrups of the first class show a much smaller conductivity, having apparently a greater resistance to the migration of the ions, and these differences in behaviour in this way probably account for the different affination values of the three classes of syrups named, which resistance may also probably have a great effect on the velocity of crystallization. Also, "conductimetric determinations," were made on different juices with the object of ascertaining the increase in the conductivity on the addition of increasing quantities of N/1 acid, this determination being a measure of the free bases and the combined bases.[1]

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[1] This chart is good, but can hardly be claimed as an improvement of that printed in MANSFIELD CLARK's book "The Determination of Hydrogen Ions."

[2] Buffer solutions which are stable for a considerable time, even in tropical climates are now being sold for use in the cane sugar industry.

[3] Contribution from the Laboratory of the Svenska Sockerfabriks A.-B., Goteburg, Sweden.

BEET SUGAR FACTORY EFFLUENTS (IN THE UNITED KINGDOM). *Report of the Standing Committee on River Pollution of the Ministry of Agriculture and Fisheries.*[2]

Reporting on work done in 1925, it is remarked on this subject that the manufacture of sugar from beet in this country brings with it the risk of a new form of river pollution which may have serious results since every beet-sugar factory of necessity employs large quantities of water. During the period of manufacture (between October and March) it is calculated that a factory dealing with 1,000 tons of beet per day will use for transporting and washing 4,000,000 gallons of water, and, in the actual process of extraction, 600,000 gallons. The need for the use of such large quantities of water involves the necessity for erecting each factory in proximity to a stream. The water used in transporting and washing carries with it a large amount of inorganic matter (earth, stones, etc.), and a certain amount of organic matter (beet "tailings," etc.), the former of which, if the water were discharged directly into the stream, would obstruct the flow by creating banks of silt, while the latter would foul the water with decomposing vegetable matter. The water used in the process of extraction contains a certain amount of suspension and large quantities of organic matter in solution, the effects of which on the stream are certainly deleterious. There is evidence that the effluents from such factories are liable to cause injury to stream life, either by direct poisoning, or by causing the development of a mass of sewage fungus, or by both means. In all cases the enormous quantities of water used render the solution of the problem extremely difficult. So far as direct fish poisoning is concerned, the bulk of the water as delivered from the pulp presses is comparatively harmless, but poisons may be set up by subsequent decomposition. It is, therefore, possible that less harm would be done to the river by the direct discharge of the pulp-press water into it than by discharging from a settling pit, but this question can only be settled by observations and research. At the request of the Committee, the Ministry has caused inquiries to be made in the various countries abroad in which beet-sugar is manufactured as to the experience of those countries of the effects of such effluents and of methods of treating them so as to prevent injurious pollution. A number of reports have been collected and are now undergoing examination. But from a preliminary survey of them it appears to be doubtful whether any satisfactory process of treatment has yet been discovered which is at the same time efficacious and economically practical.

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[1] I. M. KOLTHOFF: "Konduktometrische Titrationen" (Dresden and Leipzig), 1923.

[2] H.M. Stationery Office. Price: 6d.

Colour Formation in the Beet Factory. **H. A. Schlosser.** *Centr. Zuckerind.*, 1926, 34, No. 17, 404-407. Previous to graining, 16.86 per cent. of colour was formed; during graining, only 6.47, but after graining 76.67 per cent. Of the total colour of raw massecuites, the crystals separated retained 14.46 per cent., and the molasses 85.54 per cent.—Some Factors influencing Sedimentation. **Clark S. Robinson.** *Industrial and Engineering Chemistry*, 1926, **18**, No. 8, 869-871. An analysis is made of the rate of settling of suspensions in water, such as fine silica, of known specific gravity, of particles of known diameter. It was found that a modification of the Stokes' law of settling is applicable to fine sludges of this kind, permitting an analysis of settling rates and the prediction of the time required to settle.—Permanent Lead Paint for Ironwork. **Anon.** *Science News-Letter*, 1926, **9**, No. 273. Metallic lead in colloidal form dispersed in yellow lead oxide and mixed with linseed oil is said to form a permanent paint for ironwork, the very minute particles of the lead separating out, and gradually penetrating into the surface of the iron. Iron objects thus painted are said not to have shown any signs of rusting after prolonged exposure, or after being heated in steam.—Spectroscopic Measurements for judging the Quality of Affination and Char Work. **Harald Lunden.** *Centr. Zuckerind.*, 1926, **34**, No. 19, 468-469. Beet sugars of low refining values are found to have the following characteristics : (1) A decrease in the light absorption at 6000 Angstrom units on changing the alkalinity from *pH* 7 to 10 ; (2) A small increase of the absorption of light from orange to blue (6000 to 45000 A. u), or in other words a relatively large absorption of affined sugars at 6000 A. u. Examination of the form of the absorption curve enables one to form a conclusion as to the efficiency of the clarification in the raw beet factory.—Filtration of Raw Sugar Liquors using Vegetable Decolorizing Carbons. **P. Honig.**[1] *Tijdschrift*, 1926, 138-148. Among the substances strongly imhibiting filtration the most pronounced in their effect are the lyophilic colloids and especially the compounds which are grouped under the names of gums and pectins, which, however, exert least influence in the neighbourhood of their neutral point. Intensive drying of raw sugar improves its filtering qualities. —Preservation of Colorimetric Standards for the Determination of Hydrogen-ion Concentration. **Sydney L. Wright, Jr.,** *Bull. Ayer Clinical Lab. Penna. Hosp.*, 1925, **9**, 63-64. Standard solutions of known hydrogen-ion concentration (*pH*) may be preserved for periods as long as eighteen months with a fair degree of success, provided they be sealed in glass tubes, then sterilized at a pressure of 15 lbs. These solutions are prepared by addition of a suitable indicator (such as phenol red or bromthymol blue) to a buffer solution such as a phosphate mixture of definite composition.—Planting Beet Seed according to Size. **A. F. Kiehl.** *Centr. Zuckerind.*, 1926, **34**, No. 20, 511. The smallest seed ball contains only 1 seed grain ; the second smallest, two ; the third, three, and so on ; and the energy of growth of the seed also depends on the size of the balls. Therefore all the seed balls produced by the grower should not be planted for the best results, but only the largest of them—Polarizing Constants of Raw Cane Sugars. **F. W. Zerban, C. A. Gamble, and G. H. Hardin.** *The Planter*, 1924, **77**, No. 6, 108-109. Raws examined at the N.Y. Sugar Trade Laboratory showed an average value for **(S—P)/I** (Browne's dextrose : levulose ratio[1]) of 0.230, the sucrose (S) being determined by double polarization using invertase (96.28 per cent.), and controlled by Jackson and Gillis' acid methods II and IV (96.34 per cent.); the direct polarization (P) after de-leading with potassium oxalate; and the invert sugar (I) by Allihn's process. But during May to July the ratio averaged only 0.139, due probably to torula decomposition.—Bibliography H.I.C. **Louis E. Dawson.** *Sugar*, 1926, **28**, 211-4, 262-4, 310-2, 369-70. References to 103 papers on *pH* determination are given, a good number of which deal with the quinhydrone electrode method.[2]—Levulose Production in Germany. **B. Hoche.** *Deut. Zuckerind.*, 1926, **51**, No. 25, 730-731. Referring to the valuable work of the Bureau of Standard levulose production,[3] it is said that in 1920-22 the Salus-Nahrmittel-Werke, of Schonebeck a. E., extracted inulin from chicory, following the beet factory, viz., diffusion, followed by carbonation, filtration, and crystallization, afterwards hydrolysing the inulin in the Anhalt refinery, and using the final molasses for making " coffee essence " or for cattle food, the yield of levulose, however, being only 4 per cent. It is admitted, on the other hand, that the idea of the American chemists of hydrolysing the inulin, psuedo-inulin, helianthebin, etc., hardly presents any difficulty in practice, and in fact promises success. Beet factories would find in it the means of extending their campaign, and it might be possible by selection to increase the inulin content of the chicory plant by selection.—Purification of Beet Factory Waste Waters. **H. Grevemeyer.** *Deut. Zuckerind.*, 1926, **51**, No. 19, 513-515. Press and diffusion waters are double fermented, first in deep pits at 30-40°C., and second in other ponds after 80 per cent. of the lactic acid formed has been neutralized. After filtering, an albumen free water which will not foul when discharged into the river is obtained.—*pH* of French and German Molasses. **Em. Saillard.** *Suppl. Circ. hebd.*, 1949 *of* 1926. Using a potentiometer with hydrogen and calomel electrodes, 13 French molasses out of 17 were found to have a *pH* above 7, the average being 7.5, though 15 of them were acid to phenolphthalein. According to Herzfeld's recent analysis,[4] out of 67 German molasses all had a *pH* above 7, the average for raw factory molasses being 9, and for white sugar factories, 8.6, so that the German product is much more on the alkaline side than the French.—Climatic Effects in the Metabolism of the Beet. **W. E. Tottingham and S. Lepkovsky** (and others). *J. Agric. Research*, 1926, **33**, No. 1, 59-76. Reducing sugars in the leaf blade increase with solar radiation, temperature being a limiting factor in the increase of these sugars. The foliar fluctuations of reducing sugars in the leaf are distantly paralleled by the deposition of sucrose in the root, while relatively high temperatures increase the percentage of protein stored in this organ.—Unification of Saccharometers (Hydrometers). **D. Sidersky.** *Bull. Assoc. Chim. Sucr.*, 1926, **43**, No. 10, 401-408. According to this chemist, it is time to replace the German Brix hydrometer by a French instrument, graduated according to the Vivien formula, that is, in kilos of sugar per hectolitre of liquid, a " thermo-corrector " being provided indicating the division to be added when the mercury thread is higher than the normal point, or to be subtracted when it is below. Normal temperature to be adopted for this Vivien hydrometer is not suggested.—" Ketol " : A New Motor Fuel. **M. Depasse.** *Bull. Assoc. Chim. Sucr.*, 1926, **43**, No. 10, 409-414. An outline is given of the production of " Ketol "[5]: Sawdust is hydrolysed with dilute sulphuric acid under pressure; washed; extract mixed with beet factory carbonation scums; allowed to ferment under certain conditions to form butyric acid; evaporated and crystallized; the calcium butyrate dry distilled; and the volatile products formed rectified, those coming off between 60 and 120°C. forming an excellent motor fuel, about 7·8 per cent. superior to petrol. J.P.O.

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[1] Laboratory of the General Norit Co., of Amsterdam.

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[1] *I.S.J.*, 1919, 38. [2] See also *I.S.J.*, 1926, 498. [3] *I.S.J.*, 1926, 325. [4] *I.S.J.*, 1926, 330. [5] *I.S.J.*, 1926, 271.

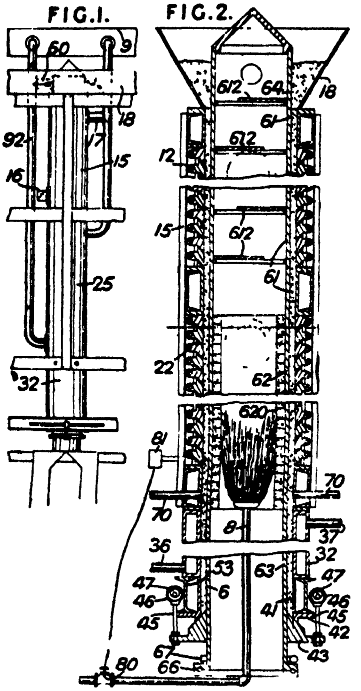
Review of Recent Patents.[1]

UNITED KINGDOM.

REVIVIFICATION OF ANIMAL CHARCOAL (BONEBLACK).* **C. W. Burroughs**, of Montreal, Canada. 255,079. July 8th, 1926; convention date, July 8th, 1925.

Wet char is dried in a thin layer, and further heated, possibly in an inert atmosphere with continuous withdrawal of the water vapour and other gases which are evolved, the bonechar being finally cooled before being exposed to the atmosphere. Fouled bonechar may be charged into a hopper 18, Fig. 2, encircling the section 64 of an inner shell which comprises drying sections 61, a heating section 62 and a cooling section 63. An outer casing 15 is provided; and surrounding the drying and heating sections are rings 12, 22, respectively, having bevelled edges which permit the gases evolved to pass between them. The heating section 62 which is preferably lined with fire-brick 620 is heated by means of a burner 8, the combustion gases rising between baffles 612 in the drying zone 61. Between the latter and the casing 15 air is circulated, air inlet 16, Fig. 1, and outlet 17, being provided. The combustion gases leave the inner shell 6 through a pipe 60 and are passed either directly to a flue 9 or indirectly, after being introduced into the space surrounding the heating zone by means of a pipe 92. Air may be introduced into the heating zone through pipes 70 when decarbonization takes place. Surrounding the cooling zone is a jacket 32, water entering at 36 and leaving at 37. Below the water jacket and secured to a girder 53 is a section 41 having a bevelled edge 42 and between this and a corresponding edge of a ring 43 which closely fits the lower section 63, the char is discharged. Means are provided for raising and lowering the ring 43, consisting of bolts 45 having straps 46, 46 mounted on eccentrics on shafts 47, 47. A thermostat 81 connected with a fuel valve 80 permits of temperature control. The lowest section 63 is supported on a ball-bearing base 66 and the section 61 has a bearing upon the top section 64 which is fixed, thus enabling the inner casing 6 to be rotated by means of gearing 67. The apparatus can be used for the treatment of any moist granular material requiring heating in an ordinary or inert atmosphere, followed by cooling.

FIG. 1. FIG. 2.



FORMATION OF CALCIUM TRISACCHARATE IN THE STEFFEN PROCESS OF EXHAUSTING MOLASSES.[2] **Carl Steffen**, of Vienna, Austria. 255,175. April 27th, 1925.

Tricalcium saccharate poor in lime and rich in sugar is produced with a reduced consumption of lime from a cold molasses or impure sugar solution by subjecting the solution, immediately after the addition of the powdered lime, to a vigorous and thorough mixing, the liquid then passing to a main collecting receiver. The liquid is circulated repeatedly through the apparatus until the desired amount of saccharate is obtained. In the process described, the cold dilute molasses or sugar solution is forced by a pump to a container where powdered lime is uniformly supplied to the rapidly flowing solution from an apparatus above. The liquid then flows to the mixer and thence to the collecting receiver from which the pump circulates it through again. A specific example of the process is described.

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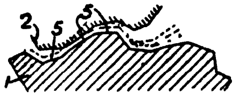
[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany*: Patentamt, Berlin, Germany.

[2] See also *I.S.J.*, 1926, 228,450, 624; 1926, 116.

TOOTHED MILL ROLLERS. **Soc. Francaise de Constructions Méchaniques, Anciens Etablissements Cail,** of Paris, France. 253,888. June 4th, 1926; convention date, June 22nd, 1925.

FIG.6.



Claim is made for a pair of co-operating rollers the peripheries of which are provided with teeth or corrugations the outline of which is such that a space of constant width is left between them. The teeth are arranged in chevron fashion across the rollers, and may be symmetrical, or of a symmetrical form as shown in the drawing, which shows the space 5 between the rollers 1, 2 in successive positions.

UNITED STATES.

"SAVE-ALL" FOR EVAPORATORS AND VACUUM PANS. **Pedro Mir,** of San Pedro de Macoris, D.R. 1,581,220. April 20th, 1926.

An outer shell is provided, which may comprise a truncated conical body 10 having at one end an oppositely tapered truncated conical shorter portion 11, the bases of the cones being thus juxtaposed. The adjacent ends of body 10 and end 11 are formed with outwardly directed annular flanges 12 secured by rivets 13 or other suitable means. The flanges 12 are shown as separate elements of angle form in cross section and rivetted as at 14 to the body 10 and end 11, respectively. An inlet pipe section 15 is secured by annular elements 16 of angle form in cross section, riveted as at 17 to the pipe 15 and end 11. The flanges are outwardly directed members, the elements being fastened by rivets 18. The pipe 15 leads from the vacuum pans (not shown) in practice to conduct the vapours into the "save-all." To the smaller end of the body 10 is connected the outlet pipe 19 leading to the condenser (not shown), the connexion being established by annular elements 20, 21 riveted as at 22 to the body 10 and to pipe 19 and riveted to each other as at 23. Within and spaced from the outer shell is provided a pipe 24 open at one end to the outlet pipe 19 and suitably secured to said pipe as by rivets 25. The opposite end 26 of pipe 24 is closed, and disposed oblique to the axis of said pipe, so that the top portion of the pipe is the longer. Said pipe 24 has perforations 27 at the top, the total joint capacity of which is in practice twice the capacity of the outlet pipe 19 so as to insure a free passage of the vapours through the con-

Fig. 2.

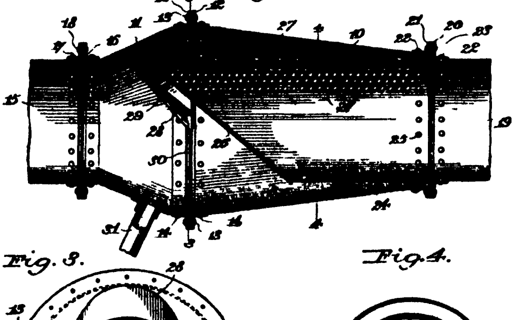


Fig. 3.

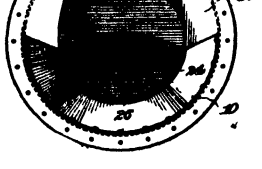
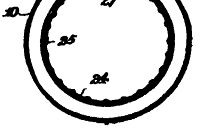


Fig. 4.

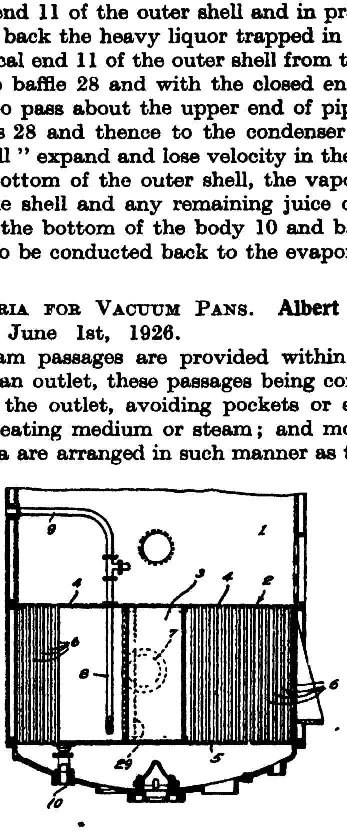


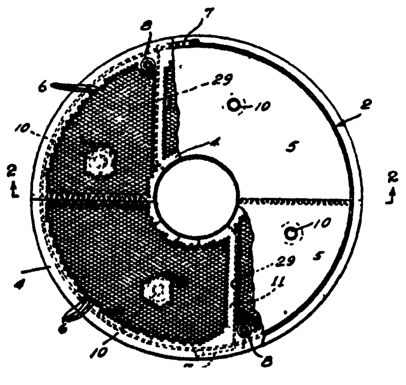
denser. In front of the closed end 26 of pipe 24 at the top portion is a baffle 28 V-shaped in cross section, so that said baffle tapers toward the front and flares rearwardly. The baffle 28 is spaced from the adjacent end of pipe 24 so as to form a passage 29 between said baffle and the closed end 26 of said pipe. Baffle 28 is formed with an outwardly directed flange 30 which is secured between the annular angle elements 12 to be held by the rivets 13. A discharge pipe 31 leads from the conical end 11 of the outer shell and in practice connects with the vacuum pans to conduct back the heavy liquor trapped in the shell. In practice the vapours enter the conical end 11 of the outer shell from the inlet pipe 15, and the vapours contact with the baffle 28 and with the closed end 26 of pipe 24. Said vapours thus are caused to pass about the upper end of pipe 24 through the passage 29 to the perforations 28 and thence to the condenser by pipe 19. The vapours entering the "save-all" expand and lose velocity in the end 11 causing the heavy liquor to drop to the bottom of the outer shell, the vapours being further expanded in the body 10 of the shell and any remaining juice or liquor accompanying the vapours will drop to the bottom of the body 10 and back to the end 11 and to outlet pipe 31, thence to be conducted back to the evaporating pans.

CALANDRIA FOR VACUUM PANS. **Albert P. Leonard,** of New York. 1,586,814. June 1st, 1926.

Steam passages are provided within the calandria extending from a steam inlet to an outlet, these passages being constructed to diminish gradually from the inlet to the outlet, avoiding pockets or eddy-producing obstructions in the path of the heating medium or steam; and more particularly the heating tubes of the calandria are arranged in such manner as to obtain the maximum area for the introduction of the steam therebetween at the receiving end of the passages referred to. In Figs. 1 and 2, an evaporator tank 1 is equipped with a calandria 2 provided with the usual central downtake passage 3, top plate 4, and bottom plate 5 between which extend the usual circulation pipes 6. Steam inlets 7 are provided at opposed points in the calandria. Steam is the preferred heating medium. The non-condensible gases are expelled through outlet pipes 8 leading to the outside by means of conduits 9. The invention resides in the particular disposition of the steam inlets and baffles within the calandria whereby steam will be evenly distributed throughout the entire portion of the calandria and have a uniform temperature from its point of entry to its outlet. Baffle plates 29 are therefore provided adjacent each inlet 7 and extending upon a slight angle from each inlet to the downtake (Fig. 2). By this construction, using two steam inlets and two baffle plates, the calandria is divided into two chambers of similar dimensions and configurations from which the products of condensation within the calandria are drained through outlets 10 disposed at suitable points. As is usual, the interior of the calandria is taken up by the circulation tubes 6

Fig 1





which are disposed in spaced relation to permit of the passage of steam therebetween and occupy the entire space within the calandria with the exception that adjacent each baffle plate 29, the pipes 6 are spaced therefrom to provide a steam passage 11 extending from the steam inlets 7 across the calandria to the walls of the downtake 3. By this construction, when steam is admitted through the intakes 7 it will before entering between the circulation tubes have an unrestricted travel through the passages 11 across the entire calandria, before it begins its passage through the respective chambers therein. This provides for a uniform distribution of the steam directly adjacent the inlet. Each outlet pipe 8 is disposed at the end of its respective chamber farthest removed from the inlet and is disposed in the apex formed by the junction of the outer wall of the calandria with the baffle plate 9. By reason of the location and disposition of the baffle plates, each chamber of the calandria will have its widest area directly adjacent to steam inlets, from which point the cross sectional area of each chamber decreases continuously toward the delivery end and outlet pipe 8. This insures a uniform distribution of steam throughout every point of the calandria and by reason of the continuous reduction of the cross sectional area of the chamber maintains a uniform pressure and density of the steam. The steam employed as a heating medium is most effective directly adjacent the inlet points, and the circulation pipes located adjacent the downtake pipe of the calandria receive little, if any, of the steam passing therethrough. But in this invention by the provision of the baffle plates, and the arrangement of the circulation pipes so as to provide the passageways 11 extending across the calandria, the steam is permitted before entering the chambers, to extend entirely across the calandria and enter between the circulation tubes with a uniform pressure from all points, which pressures will continue throughout the passage of the steam to the outlet conduits 8 and 9. Two other modifications are described.

CARBONATION OF BEET JUICE, ETC. **Philip J. McGuire** (assignor to the **Dorr Company**, of New York). 1,583,299. May 4th, 1926.

In carrying out this invention the juice is treated during the entire carbonation treatment at a temperature of from 185° F. to 200° F. (85-93° C.), the most satisfactory results being obtained by maintaining the temperature during the carbonation at approximately 195° F. (91° C.). In order to keep to this desired temperature throughout the carbonation treatment, the operation is conducted in appropriately insulated apparatus, preheating to appropriate temperatures all of the materials entering into the reaction. Thus, the raw juices are heated to a temperature of from 185° F. to 200° F., and are subjected to the action of milk-of-lime, calcium saccharate, or the like, which is also preferably preheated to the same temperature. If desired, the raw juice and the liming agent may be introduced into the defecator at various temperatures and subsequently heated to the desired temperature, the preferable degree being about 195° F. (91° C.). During the carbonation treatment the temperature of the liquor is not allowed to drop, but is maintained by the use of steam coils and appropriately heated carbon dioxide gas at the desired temperature of from 185° F. to 200° F. throughout the entire carbonating operation. Thus, in accordance with the invention, the carbon dioxide gas introduced into the carbonators is heated to a temperature of from 185° F. to 200° F. and this, in conjunction with the preheating of the juice itself, the insulating of the carbonators, and the supply of such additional heat as is necessary through steam coils in the carbonators, insures the maintenance of the sugar liquor at a temperature of from 185° F. to 200° F. throughout the entire carbonation treatment. The claim read as follows : In the manufacture of sugar the improvement which comprises the steps of subjecting sugar juices to the action of a liming agent at a temperature of from 185° F. to 200° F. and subjecting the limed liquor while maintained at a temperature of from 185° F. to 200° F. to the action of carbon dioxide gas of a temperature of from 185° F. to 215° F.; substantially as described.

EXTRACTION OF JUICE FROM BEETS, ETC., BY DIFFUSION. **William F. Holzheuer,** of Hale, Michigan. 1,587,646. June 8th, 1926.

Briefly the invention includes a modification of the ordinary piping connecting the various cells, and including a series of valves, and proper headers, so that after the water or juice has flowed approximately through half the cells under the force of the initial pressure, it is brought through one of the headers to a "booster" pump where its pressure is raised back to approximately the same amount as the original pressure at which the water entered the first cell, and with this boosted pressure it flows back through another header where the valves are so set that it enters the next cell in the series and flows much more rapidly through the remainder of the battery because of the increased pressure which it receives by passage through the booster pump. By thus cutting into the battery part way along its length, and boosting the pressure as just described, the total overall flow or circulation through the entire battery can be considerably increased over any previous method of operation, without introducing any detrimental features, and as above described this increased rate of circulation is of utmost value in a great many sugar factories. All diffusion batteries are operated with a definite sequence of operations progressing from cell to cell around the battery as the work proceeds, and though a particular cell may be dumped at a given time, and another cell being filled at the same time, nevertheless a few moments later it will be a neighbouring cell that is being dumped, and still another cell that is being filled, and so on. These operations proceed progressively from one cell to the next in the entire series all around the battery. In similar manner the initial water which enters the battery is at one time entering one cell and at another time another cell, and so on all around the battery in the same sequence with the other steps. Likewise therefore the particular cells in the series from which the juice is drawn off to the booster pump for the purpose of boosting the pressure and re-injecting into the series as above described, also changes from cell to cell along with the sequence of all the other steps of the operation. As one of the benefits derived from this booster circulation pressure, and not previously mentioned, there is sufficient pressure to both draw juice from the last cell into the measuring tanks, and also to force juice from this last cell up through the next cell of fresh cossettes which are being mashed. In the ordinary mode of operating a diffusion battery without boosted pressure, it is very difficult, or impossible, to obtain enough pressure at the end of the battery to both draw and mash at the same time, and for this reason these operations are usually performed one after the other, which has a further effect in slowing down the battery, and results in a benefit derived by boosted pressure as batteries equipped with same are capable both of drawing and mashing simultaneously, and this of course speeds up the overall circulation further. Claim 4 reads: An apparatus consisting of a diffusion battery having a number of cells in series, said cells being connected with each other through valves and piping so that a fluid introduced into said series of cells can circulate progressively from one cell to another, along the battery, and means for boosting the circulation pressure of said fluid at a point along its course through the battery, consisting of a low pressure header connected with various said cells through separate valves, and a high pressure header also connected to various of said cells through separate valves, said low and high pressure headers being connected to each other through a pressure boosting means, one of said valves connecting one of said cells with said low pressure header being open, while one of said valves connecting another of said cells with the high pressure header is open to cause said fluid to pass from one cell through said pressure boosting means and back into another cell at a higher pressure, substantially as described.

ROTARY DRUM FILTER. **Arthur Wright,** and **Frank W. Young,** of Upper Montclair. 1,590,401. June 29th, 1926. A centrifugal machine contains a stationary casing for the centrifugal basket, an inwardly extending annular cover for the casing, and means on the inner face of the cover causing outward flow of liquid entrained by the current of air escaping at the inner margin of the cover during the operation of the machine.—CENTRIFUGAL MACHINE. **Charles A. Olcott** (assignor to **S. S. Hepworth Co.**, of New York, U.S.A.). 1,591,004. June 29th, 1926. Claim 1.—A rotary filter comprising a drum having a plurality of filtering compartments and an outlet pipe communicating with each compartment and with a common manifold in which a low pressure is adapted to be maintained, and a 2-way cock located in each outlet pipe and adapted to bring the compartments into communication with the common manifold, and into communication with the atmosphere, also means for operating said cocks. Claim 13.—A drainage member for filtering compartments comprising wire woven into spiral intertwined formation, adapted to hold the filtering cloth away from the drum of the filter and provided for the drainage of the filtered liquid therethrough.—EVAPORATOR. **Robert H. Jackson,** of Willington, S.C., U.S.A. 1,590,945. June 29th, 1926. A "skimming evaporator" comprises a liquid-containing tank adapted to be subjected to heat, an overflow pipe arising from the tank, a trough arranged above the tank to receive the liquid from said pipe and separate the extraneous matter from said liquid, a strainer arranged within said trough in spaced parallel relation to the bottom thereof, a compartment arranged above the tanks to receive the liquid from said trough, valve controlled communication between the compartment and tank whereby the liquid is returned to the tank, and a spout projecting from said trough and through which the extraneous matter passes from the latter.—ALCOHOL DENATURING. **Emilio M. Flores,** of Buenos Aires, Argentina. 1,591,084. July 6th, 1926. Comprises adding to crude ethyl alcohol 1 per cent. of crude wood alcohol containing acetone and 1 per cent. of a light fraction of mineral oil distilling between 40°C. and 150°C.—ALCOHOL MOTOR FUEL. **Gustavus J. Esselen, Jr.** (assignor to **United Fruit Co.,** of Boston, Mass.). 1,591,665. July 6th, 1926. 1.—A fuel consisting mainly of ethyl alcohol, and containing an alkali salt of a higher fatty acid, and lubricating oil.—CLARIFICATION BY MEANS OF CHLORINE.[1] **Shuichiro Ochi,** of Toyotama and **Fusaziro Kotera,** of Ebara, Japan. 1,591,879. July 6th, 1926. Claim 1.—A process of refining sugar juice comprising the combination of the following successive steps : chlorination of sugar juice by blowing chlorine gas into the same at a temperature of not more than 55°C., removing the active chlorine therefrom, and neutralization of the treated juice by addition of an alkaline substance.—PURIFICATION OF SUGAR LIQUORS, USING BONECHAR. **Charles B. Davis,** of New York. 1,592,598. July 13th, 1926. A process is described in which sugar liquors are treated by first washing the raw sugar with water, diluting the washings to about 10° Baumé, filtering and passing through bonechar to decolorize, adding thereto the washed sugar to obtain a syrup of about 30° Baumé, refiltering and again decolorizing.—CENTRIFUGAL BASKET. **Floyd P. Breneman,** of Havana, Cuba. 1,592,717. July 13th, 1926. A centrifugal basket comprises a perforated wall, a perforated breast section above said wall and projecting diagonally inwardly thereof and upwardly therefrom, said wall and said section being provided with backing screens arranged therein and carried thereby, and perforated metal screens carried within both said backing screens, the perforated metal screen in the basket being of substantially 400 to 625 holes per sq. in. and the perforated metal screen within the basket being from 625 to 1000 holes per sq. in.—CLARIFICATION OF BEET JUICE. **E. E. Nicholson and R. B. Beal.** 1,578,463. March 30th, 1926. After treatment with an excess of lime, a quantity of a water-soluble aluminate to precipitate part of the excess of lime and other hydroxides is added. The flocculent, granular precipitate is filtered off, after which the liquid is carbonated, and again filtered.—METHOD OF TREATING SUGARS, SYRUPS, ETC., FOR IMPROVEMENT OF THEIR FLAVOUR AND SWEETNESS. **Chester C. Fowler.** 1,493,623. May 13th, 1924. Claim is made for the process of treating sugar, corn syrup, etc., for the improvement of their flavour and sweetness, consisting in mixing with a given amount about half its weight of water and nickel in proper form to serve as a catalyzer ; heating and agitating the solution in the presence of hydrogen under pressure with exclusion of air, and filtering the resulting solution to remove the catalyzer.

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[1] *I.S.J.*, 1926, 278, 332.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending September 30th.		Nine Months ending September 30th.	
Unrefined Sugars.	1925. Tons.	1926. Tons.	1925. Tons.	1926. Tons.
Poland	....	....	9,016	13,075
Germany	....	150	1,962	7,927
Netherlands	....	....	....	....
France	....	....	....	....
Czecho-Slovakia	....	....	1,030	342
Java	11,874	....	24,878	....
Philippine Islands		....	....	....
Cuba	45,855	55,586	591,446	206,623
Dutch Guiana	....	....	....	....
Hayti and San Domingo	7,335	15,576	129,804	101,633
Mexico	....	...	....	....
Peru	4,391	10,737	45,489	78,430
Brazil	....	....	6,540	95
Mauritius	146	448	16,399	151,046
British India	....	....	....	....
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	4,641	5,868	115,325	96,202
Other Countries	21,019	13,754	68,487	183,228
Total Raw Sugars	**95,261**	**102,119**	**1,010,378**	**838,600**
Refined Sugars.				
Poland	....	....	13,284	9,279
Germany	18	4,990	6,251	17,184
Netherlands	8,211	22,384	125,798	184,356
Belgium	303	1,749	12,996	9,339
France	....	....		....
Czecho-Slovakia	1,595	17,379	137,805	240,131
Java	....	....	....	....
United States of America	30,973	449	134,967	11,473
Canada	9,974	7,039	92,661	66,756
Other Countries	1,055	738	3,383	10,506
Total Refined Sugars	**52,129**	**54,728**	**527,145**	**539,025**
Molasses	5,830	14,737	130,853	119,892
Total Imports	**153,220**	**171,584**	**1,668,376**	**1,497,517**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	Tons.	Tons.
Denmark	33	135	766	983
Netherlands	35	27	193	315
Irish Free State	6,044	2,747	40,194	37,927
Channel Islands	73	118	667	616
Canada	....	....	....	...
Other Countries	474	566	6,768	21,106
	6,658	3,592	48,588	60,948
Foreign & Colonial Sugars.				
Refined and Candy	819	179	1,753	2,100
Unrefined	179	30	559	1,022
Various Mixed in Bond	....	....	....	...
Molasses	63	20	383	2,231
Total Exports	**7,719**	**3,821**	**51,283**	**66,301**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1926. Tons.	1925. Tons.
Total Receipts, January 1st to September 29th	2,649,345	2,721,837
Deliveries ,, ,,	2,488,466	2,668,555
Meltings by Refiners ,, ,,	2,485,000	2,598,580
Exports of Refined ,, ,,	66,250	238,000
Importers' Stocks, September 29th	169,535	53,282
Total Stocks, September 29th	219,279	135,264
	1925.	1924.
Total Consumption for twelve months	5,510,060	4,854,479

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924 Tons.	1925. Tons	1926 Tons
Exports	3,203,592	3,760,186	3,164,459
Stocks	432,123	822,799	945,416
	3,635,715	4,582,985	4,110,370
Local Consumption	85,000	97,000	95,000
Receipts at Ports to July 31st	3,720,715	4,679,985	4,205,370

Havana, August 31st, 1926 J. GUMA — L. MEJER

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR NINE MONTHS ENDING SEPTEMBER 30TH, 1924, 1925, AND 1926.

	IMPORTS.		
	1924. Tons.	1925. Tons.	1926. Tons.
Refined	393,685	527,145	539,025
Raw	943,701	1,010,378	838,600
Molasses	139,431	130,853	119,892
	1,476,817	1,668,376	1,497,517

	EXPORTS (Foreign).		
	1924. Tons.	1925. Tons.	1926. Tons.
Refined	4,657	1,753	2,100
Raw	7,926	559	1,022
Molasses	2,581	383	2,231
	15,164	2,695	5,353

	HOME CONSUMPTION.		
	1924. Tons.	1925. Tons.	1926. Tons.
Refined	396,442	533,309	510,919
Refined (in Bond) in the United Kingdom	699,523	654,005	636,266
Raw	101,499	75,828	110,544
Total of Sugar	1,197,464	1,263,142	1,257.729
Molasses	5,384	6,078	4,355
Molasses, manufactured (in Bond) in United Kingdom	44,291	42,345	47,254
	1,247,139	1,311,565	1,309,338

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT SEPTEMBER 30TH, 1926.

	1924. Tons.	1925. Tons.	1926. Tons.
Refined in Bond	38,950	45,750	52,650
Foreign Refined	12,800	24,900	135,100
,, Unrefined	91,350	222,800	159,600
	143,100	293,450	347,350

United Kingdom Monthly Sugar Report.

Our last report was dated the 9th September, 1926.

For the first time for about 18 months we have to report a change of sentiment and throughout the period under review all the markets of the world have undegone a change, and prices have been firm and rising. Prices generally are 1s. to 1s. 6d. per cwt. higher than a month ago.

The London Terminal Market, having recovered from the shock of the August liquidation, gradually hardened all the way through September. influenced by large purchases for the East and the restricted offers of raws by Cuba in view of the legislative control of the new crop. About 8000 tons were tendered in September and this month was traded in from 13s. 9d. to 15s., finally being liquidated at this price. October advanced from 13s. 11¼d. to 15s. 1½d., whilst a very large business was done in December from 14s. 6d. to 15s. 7½d. Forward months were not so active but considerable dealings took place in March from 14s. 11¼d. to 16s. 1½d.; May from 15s. 3d. to 16s. 5¼d; and August from 15s. 7½d. to 16s. 9d. Trading has been on a much larger scale than for the past six months. The latest prices are October 14s. 10½d.; December 15s. 4½d.; March 15s. 9¾d.; May 16s. 0¾d.; August 16s. 6d.

Trading in actual Sugars has been much more brisk. Ready sugar f.o.b. Continental ports has been scarce. Dutch Granulated has been the most plentiful and has been sold from 15s. 1½d. to 16s. 9d. German Granulated f.o.b. Hamburg sold from 15s. to 16s. 6d. Business in forward months has been more active. November/December Granulated sold from 14s. 9d. to 16s., and April/May from 15s. 6d. to 16s. 9d. Spot Granulated has advanced from 27s. 1½d. to 28s. 7½d. duty paid and a very large business has been done.

India has been a continuous buyer and it is estimated that about 150,000/200,000 tons have been sold to this country. Czecho-Slovakia, Hungary, Poland, Holland and Belgium have all participated in the sales.

Large quantities of Home Grown Sugars have already been marketed for October and also in some cases for November/December delivery. The sugar has been sold from 28s. 9d. to 29s. 9d. duty paid. The latest prices are 29s. 6d. to 30s. according to factory.

We have to report a series of advances in the prices of the British Refiners. On each of the following dates the prices were raised 3d. per cwt.:—September 13th, 20th, 21st, 23rd, 27th, 28th, and 29th, making an increase altogether of 1s. 9d. The latest prices are No. 1 Cubes 35s. 3d., London Granulated 31s. 1½d., Empire Granulated 30s.

The British Refiners have not been in the market for Cubans as the price has advanced rapidly to 14s. c.i.f., but business has been done in Peru 96 per cent. from 12s. to 13s. 6d. c.i.f. Several Mauritius cargoes have been sold from 18s. 3d. to 18s. 9d. c.i.f.

In New York the Refiners have been large buyers and have paid up to 2⅞ c.i.f. for raws, at which price a large volume of business was transacted. Cuba has also sold large quantities to Canada and the Far East.

The Futures Market has closely followed actual sugar and to-day stands about 20 points higher than a month ago.

F. O. LIGHT issued his usual estimate of the European Beet crops, his total being 7,340,000 tons against 7,457,000 tons last year. The chief reduction is in Czecho-Slovakia, 300,000 tons, and the principal increase is in Germany, 200,000 tons. It is considered in well informed circles that his estimate generally is at least 200,000 tons too high.

The news that the President of Cuba had issued a decree prohibiting the grinding of the new Cuban crop until the 1st January produced a great impression on the sugar world. No mention is made of curtailment and it would appear that if the price is 3 cents, or over, there will be no necessity to take this drastic action. Stocks in Cuba are rapidly decreasing. At the ports there are only about 10,000 tons more than last year, and in the whole Island the stock is 960,000 tons against 800,000 at this time last year.

21, Mincing Lane,
London, E.C. 3.
October 8th, 1926.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE
INTERNATIONAL
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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 335. NOVEMBER, 1926. Vol. XXVIII.

Notes and Comments.

Production versus Consumption: The 1927 Sugar Crops.

As we suggested in our September issue, the annual upward trend of sugar production, which has been a feature of recent years and has led to consumption being outrun with disastrous economic consequences to the sugar market, will cease in the coming season's crop and a decrease, as compared with 1925-26, of nearly 100,000 tons is foreshadowed. Messrs. Willett & Gray have issued their annual first preliminary estimate of the world's crops several weeks earlier than usual; this is as well, since the whole sugar world was anxiously waiting for signs of a definite change. The figures put forward by these eminent statisticians, though offered with their usual reserve, suggest that the total cane crops of the world for the 1926 27 season will come to 17,070,000 long tons. This, however, assumes a Cuban output of full capacity, viz., of 5,200,000 tons; but though nothing is definitely known at the moment as to what restrictions will be enforced by the Cuban President other than the holding up of the grinding till January 1st, it seems very unlikely that he will in the face of advice from the Association of Cane Growers (who favour a maximum crop of four and a half million tons) allow a crop of over five million tons to eventuate. Governmental restrictions apart, there is the loss due to the Havana hurricane—referred to below—which seems good for a reduction of at least 300,000 tons in the island's crop. It would seem, then, that the chances of Messrs. Willett & Gray's provisional figure being reached are not great; and the actual output of sugar may show a much bigger decrease than the hundred thousand tons above indicated. We must add that Willett & Gray are careful to explain that their forecast of Cuba only takes in the crop capabilities, and for the moment ignores the restrictive possibilities foreshadowed.

Apart from Cuba the principal decreases are in Java where the crop will be smaller by some 340,000 tons; Mauritius where the latest advices indicate a reduction of some 45,000 tons; and Australia where a reduction of nearly 100,000 tons is expected. On the other hand, Brazil shows an increase of 50,000 tons and Argentina 45,000 tons—this in countries where the market is already demoralized through excess production last season. But, generally speaking, the decrease is well spread all over the sugar world and rather suggests the depressing influence of an unremunerative price. The supply of Empire sugar, it may be observed, shows a reduction by some 160,000 tons, mostly in Mauritius and Australia.

The beet sugar crops are estimated at 8,209,000 tons as compared with 8,272,365 tons last year. Europe shows a decrease of about 116,000 tons, while the United States expects to turn out 56,000 tons more.

The grand total of cane and beet sugar is thus estimated by Willett & Gray at 24,279,000 long tons, as compared with 24,375,813 tons in 1925-26, a decrease of 96,813 tons. This in effect is the amount that may be expected if all the cane grown is ground at the mills. For further details of the estimate, the reader is referred to the tables at the end of this issue.[1]

The Cuban Hurricane and the Coming Crop.

Nature has unexpectedly come to the aid of Cuba in her attempt to reduce the coming sugar crop to more economic dimensions, though naturally not in equitable fashion. An exceptionally violent hurricane swept the western end of Cuba during the second half of October and, besides razing to the ground many of Havana's buildings, played havoc amongst the sugar plantations lying in its path, which comprised the three provinces of Havana, Matanzas and Pinar del Rio. At least 15 mills are reported to be seriously damaged while others have suffered more or less injury. The damage to the growing crops in the affected zone is put at 30 to 40 per cent. of the crop in that zone. Including the sugar damaged in store in Havana, this would appear to comprise a loss of some 300,000 tons of sugar. As for the damaged mills, if reports are to be relied on, they are in many cases too seriously injured to be able to grind this coming season, in which case their surviving cane will be wasted if it cannot be transported by rail to unaffected factories; and factories less seriously injured will be faced with a shortage of repairing labour, due to so much destruction of buildings in Havana.

This is a very serious loss, and falling as it does on one section only of Cuba is disproportionately severe in its incidence, since in the worst cases it may eliminate the victims of the storm from participating in any of the proceeds of the next crop. The latter was bound under Government intervention to be reduced from the high figure of the 1925-26 crop; and the Committee of Cane Growers would appear to be of the opinion that the coming crop should be limited to four and a half million tons. The question now is, will the loss due to the hurricane be taken into account in arriving at that limit? If so, the mills that have escaped the catastrophe will naturally suffer less reduction in their quota.

The Mauritius Crop storm-damaged.

Cuba is not the only cane sugar territory to suffer from storm damage, since Mauritius was struck by a moderate but sustained cyclone last April which in the end has proved more damaging to the crop prospects than was at first apparent. A preliminary survey of the damage caused put it at 35,000 tons of sugar, but more recent advices have shown that this was an under-statement by fully 10,000 tons, so the 1926-27 crop should not exceed 200,000 tons, the export quota being put at 185,000 tons as compared with 230,000 tons last year. Unfortunately, as the Mauritius crop season is from August to January, it may be difficult for this loss to be partly neutralized by a better price being obtained for the sugar this season; at the time of writing there is a distinctly better feeling in the sugar markets, but there is still too much unabsorbed sugar about for world prices to alter materially for a few months to come. It is the 1927 crops that will stand to gain by the improvement in prices that is foreshadowed.

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[1] As we go to press, we learn that Messrs. Willett & Gray have reduced their estimate by over 400,000 tons, due to European and Cuban decreases. See page 628.

The British 1926 Beet Sugar Campaign.

The beet sugar campaign in England and Scotland has started this season under favourable auspices and the factories have been in full swing for the last few weeks. The favourable weather of mid-September added much to the sugar content of the roots, which are everywhere reported to be much above the average ; while the frosts which put in an appearance in October do not appear to have been severe enough to do any material damage. Cantley is slicing about 1500 tons daily. Kelham reports a very high sugar content in its roots. Spalding, which was unable to start last year owing to lack of an adequate water supply, has now got ample water, and being able to get delivery of foreign coal by water has been able to make a good start ; it is expected to deal with 65,000 tons of roots during its initial campaign. Peterborough, which has been built in the short time of eight months has started to time and is dealing with 500 to 600 tons daily, as against its designed capacity of 700 tons. Felstead has also started its first campaign, and hopes to slice in all 60,000 tons of beets. The roots within its area are expected to average 17 per cent., while some of the first lots attained 19·8 per cent. Colwich is hoping to slice 110,000 to 120,000 tons, as against 75,000 last season. The reports of roots grown at Cupar in Fife are also very favourable.

The Yeovil factory project has after all been abandoned, largely owing to the fact that it was not an ideal centre for deliveries in the West of England. Devon and Cornwall for instance would prefer a factory near Exeter, and the available support round Yeovil was not sufficient to warrant a factory being proceeded with in that Somerset district. Good progress is, however, being made with the plans to erect and work a factory in the Wellington district of Shropshire, in the 1927-28 campaign.

Tate & Lyle affected by the Glut in Sugar.

For months past there has been a glut of sugar in this country, much of it foreign refined, which has made it difficult for our home refiners to find a market for their standard output. The last straw has apparently been the arrival of the home beet sugar season when the crop has to be marketed in the comparatively short period of three or four months. This year Home Beet is expected to contribute about 150,000 tons of sugar to our consumption, nearly all direct refined. so anything up to 50,000 tons will be offered the market each month for the period concerned. In view of this (and of the fact that there is at the moment a surplus stock of Continental dumped sugar in London alone amounting to 100,000 tons, while the home consumption is about 140,000 tons a month), our premier refiners, Messrs. TATE & LYLE, LTD., have decided that they cannot for the next few months carry on with their full refinery output, and so they decided about the middle of October to close down most of the Lyle refinery at Plaistow Wharf and put the Silvertown refinery on short time. The bulk of the work done will be confined to turning out Tate & Lyle specialities, a feature that the firm have been increasingly developing of late.

This temporary cessation of work is much to be regretted, but we do not think the refiners are justified in laying the principal blame for their temporary eclipse on the subsidized home beet industry. It has long been a grievance of theirs that this subsidy is paid on the scale of finished white sugar at the beet factory and not, as they would have it, on the sugar in its raw state only. But if the subsidy did stop at the raw stage, is it likely that the modern beet factory would be content to turn out raw sugar only (to be sent to the bonechar refineries) and not rather finish the refining at their own factory in one operation, thereby reducing a good deal of handling and transport costs ? If the subsidy were further arranged so that it would not pay the factories to complete the final process of refining by themselves, then it would simply amount to the boot being on the other leg, that of the refiners. But since the beet sugar industry in this country has got to justify its existence, it ought not to be harassed by any restriction on its inclinations to turn out the type of sugar that will pay it best. And modern beet sugar producers are increasingly disposed to turn the finished sugar out by themselves and market it without further delay. Science has come to their aid to enable them to do this and will continue to assist them to perfect the operation. The clock cannot be put back, so to speak, in this direction.

The refiners have much more cause for complaint that refined sugar is being dumped into this country from the excess stocks of foreign refiners.[1] American refined in particular has made since the Armistice a bold bid for a share of our market, and this sugar being surplus to its own country's requirements can obviously be sold over here at a low rate. The remedy is to do what practically every other country does and differentiate against it in the Customs Duty. Unfortunately the present Parliament got no clear mandate from the electors at the last polls to impose tariffs right and left, so free imports of refined sugar, as of many other manufactured commodities, are still competing with the product of home workers, when they might but for the politicians be properly restricted. Of the three political parties in the country, the one in power has certainly the will, if not the mandate, to remedy the injustice ; the Liberals are largely unrepentant free traders ; while Labour is coming round to the idea of protecting home workers by some form of fiscal expedient or other, but unfortunately in the case of sugar the majority of them are too much attached to the idea of the so-called "free breakfast table" to make them disposed to assist home sugar workers as against home consumers. The present experience of the big refiners in this country—which, be it noted, might equally well have been caused by a glut of foreign refined only, given the quantity available was big enough—should emphasize the undesirability of letting foreign surpluses of any form of food be dumped into this country.

Development of Empire Sugar Resources.

The meeting in this country just now of the Conference of Premiers and representatives of the various territories of the British Empire to discuss ways and means of furthering Imperial trade and communications is a periodical feature that demonstrates the better understanding now existing between the Mother Country and its overseas Dominions, Dependencies, and colonies, not only those which are still ruled from Downing Street, but those which have a complete independent constitution as far as internal government is concerned. It is becoming increasingly patent that the United Kingdom will have to depend in the future to a much larger extent than in the past on a trade reciprocity carried out with all parts of the Empire, and much remains to be done to carve out the channels along which such trade will the more easily flow. The British Empire Producers' Organization is of course alive to this fact, and it has taken the opportunity offered by the meeting of so many Delegates to this sitting of the Imperial Conference to put before them a number of considerations covering the development of Empire resources and trade.

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[1] Some 70,000 tons has been imported each month for the last nine months.

In so far as sugar is concerned, the following useful data are offered. Of the total world sugar production, the Empire produced 11·9 per cent. in 1880, 19 per cent. in 1914-15, and 16·3 per cent. in 1924-25 ; but this proportion, even, must be discounted by the fact that two-thirds of it is low quality sugar, produced in India and consumed locally ; India is in fact a large importer of white sugars. Of the imports into the United Kingdom, 24 per cent. were Empire produced in 1880, only 8·5 per cent. in 1914, 21·7 per cent. in 1920, and 16·4 per cent. in 1924.

The institution of Imperial Preference on sugar came just in time to save the Empire industry from utter destruction at the hands of foreign combinations, and the consumer in Great Britain from the high prices foreign domination would have imposed on them. But the danger is not completely averted. Before the war we had the Cartel system to contend with ; since the war the United States have seized the opportunity, assisted by their high tariff walls, to attack the British market with their surplus sugars. The U.S.A. rose from the disposal of 7 per cent. of the world's cane crop at the beginning of the century to nearly 40 per cent. in 1924. By this time the middle-European industry began to revive, and considerable plans are being made, financed largely, it is alleged, by American capital, to renew the attack on this market. It is therefore essential in the view of the B.E.P.O. to take further steps to safeguard the United Kingdom supply by increasing the proportion from Empire sources. The Organization consequently is urging on the Conference the desirability of giving effect to three principal reforms : (1) The granting to Empire sugars of free admission into this country for a period of ten years, together with an assurance that should the existing duty on foreign sugars fall to a lower rate, compensating advantages should be given to Empire sugars ; (2) That the Empire Marketing Board (a recently instituted body) should take steps to assist in the development of sugar propaganda to augment the consumption of this essential commodity in order to increase supplies from within the Empire ; and (3) that the promotion of research into field and factory methods of sugar production be supported by the Governments concerned and the Empire Marketing Board, acting on the advice of the organized sugar producers of the Empire.

Peru's Agricultural Resources.

Peru, from the agricultural point of view, may be regarded as a little known country. While we have a pretty comprehensive knowledge of its former political history, especially of the details of the Spanish invasion in the early part of the 16th century, we have little more than hints as to the well developed agriculture existing at and before that period. But its internal movements in earlier times are more or less obscured, chiefly by the absence of a written language while under the rule of the Incas. The subsequent history of Peru has drawn little attention, probably because the country is quite off the main routes, and the part nearest to the sea has presented the appearance of an elevated desert, where little expansion could be hoped for. Within comparatively recent years, Peru has emerged as a country from which our spinners of fine cotton can obtain supplies of an excellent quality, and they have made the product practically their own. It has also been observed that sugar cane can be easily grown and that it has remarkably good juice. All of this agriculture depends on the annual melting of the snows of the gigantic range of mountains in the background, the Cordilleras, and is located in the narrow valleys near the coast which have been cut out by numerous small rivers. But details of these crops have been difficult to obtain largely because of the absence, as far as we know, of any agricultural experiment station in the country.

A good deal of information has now been collected regarding the cotton crop, chiefly from American sources and the excellent recent supplements of the *West Coast Leader* : the kinds of cotton grown, their distribution and the changes taking place, the methods of cultivation and irrigation, the relative values of the different staples, and the methods of marketing. But details regarding the sugar cane crop have been much more difficult to obtain, and we therefore feel justified in drawing the attention of our readers to the excellent description presented by A. H. ROSENFELD, who was deputed early this year, by the United States Tropical Research Foundation, to make a thorough study of the agricultural practices in the cane fields. This paper is full of just those details which we have hitherto lacked, concisely presented by an experienced agricultural technologist, who has devoted himself to the study of the sugar cane in many portions of the New World. It has long been known that the cotton and cane fields of Peru are little affected by the diseases which have wrought such havoc in other parts of the world, and the explanation of this freedom in the sugar cane, given by ROSENFELD, is not the least interesting part of his paper. It is also noteworthy that the much abused Bourbon variety is the one chiefly grown, presenting powerful support to the view, expressed during recent years, that the almost universal failure of this fine cane should be attributed rather to the deterioration of the soil in cane cultivation than to an inherent degeneration or senescence of the cane itself. This implied accusation against present day cane agriculture should be taken to heart in all cane growing countries.

Leaf Diseases in the Cane Fields.

The spotting of the leaves of the sugar cane is a common phenomenon in the tropics, and varies considerably year by year in its severity. Quite a number of different forms may be readily distinguished by the most casual observer, as differing in shape and colour ; and the planter is usually quite justified in neglecting them, as of minor importance from the crop point of view. But, occasionally, individual plants stand out as being completely changed in appearance from this cause ; for, in place of the green healthy colour, they strike the eye as yellowish or brownish patches ; and on examination are found to be covered by spots of only one shape and colour. Such plants are obviously unhealthy, and will produce inferior canes at reaping time. Quite a number of these spots have been traced by mycologists to the attacks of individual fungi, but the matter, even by them, is usually regarded as of more scientific than economic interest. The Eye Spot Disease in Hawaii, caused by a leaf fungus, owes its importance primarily, perhaps, to the fact that it has concentrated its attack upon H 109, one of the finest canes in these islands ; and especially because it is met with chiefly on the most fertile lands, from which the great yields of sugar obtained with this cane have astonished the sugar cane world. The paper in the present number of the Journal, discussing this outbreak, is designed to draw the attention of planters in other sugar cane countries to the possible developments of some of their leaf spots to similar serious dimensions. Fungi are curious things, and not infrequently, after many years of comparatively harmless growth upon a plant, have been known suddenly to so increase in numbers as to be of very considerable economic importance.

Sugar Technologists' Meeting, Havana 1927.

We learn that the distance between Sydney and Havana will not deter the Australian sugar industry from having a strong delegation at the convention of the International Society of Sugar Cane Technologists, which convenes in Havana, Cuba, March 14th, 1927. In a letter to the general chairman of the Society, Mr. E. W. Knox, general manager of The Colonial Sugar Refining Company, Ltd., writes that the four representatives of his company at the Honolulu convention, August, 1924, M. S. Barnett, Hunter Freeman, and D. S. North, of Australia, and H. F. Clarke, of Fiji, returned with a keen sense of the advantages to be derived from the exchange of views at the first international sugar meeting. He believes that the Havana meeting will present even greater opportunities, and says that arrangements are being made by his Company to send several representatives.

It is recognition of this sort by sugar companies, experiment stations, and government bureaux, of the value of a convention which will bring together sugar technologists from all over the world, that is going to make the Havana meeting a most important event. Among those who have thus far signified their intention of attending the convention we may mention: W. A. Orton, of Washington, D.C., director of the Tropical Plant Research Foundation; F. W. Zerban, of New York, chemist of the New York Sugar Trade Laboratory; W. W. G. Moir, of Honolulu, consulting agriculturist of the group of ten plantations represented by American Factors, Ltd.; E. E. Hartmann, of New York, representative of Petree and Dorr, Engineers; F. S. Earle, of Cuba, who has been prominently connected with the scientific phases of sugar cane agriculture in Cuba and Porto Rico since 1904, and now connected with the sugar cane variety work that the Tropical Plant Research Foundation is doing for the Cuba Sugar Club; Augusto Bonazzi, of Cuba, director of the Chaparra Agricultural Experiment Station at San Manuel, Cuba; Arthur H. Rosenfeld, till lately special technologist of cane for the Insular Experiment Station at Rio Piedras, Porto Rico; Dr. W. E. Cross, of Argentina, director of the Tucuman Sugar Experiment Station; Masato Ishida, of Formosa; E. W. Brandes, of Washington, D.C., pathologist in charge, Office of Sugar Plant Investigations, U.S. Department of Agriculture; William L. Owen, of Louisiana, bacteriologist at the Louisiana Sugar Experiment Station, Baton Rouge. Official representatives of the Hawaiian Sugar Planters' Association and the Association of Hawaiian Sugar Technologists are expected as a matter of course; and a strong delegation is also expected from Formosa.

Other noted technologists will, it is thought, arrange to be present at the meeting. The above early list shows however that the Havana gathering promises to be a strongly representative one of the world's sugar industry.

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The German Beet Sugar Crop.

From practically all parts of Germany reports come to hand that the crops of beetroot during the present season show a better result than in the previous year and that the average sugar content will be higher. Taking these facts into consideration, it is estimated that the present campaign

(1926-27) will yield a production of about 1,800,000 metric tons of sugar (estimated as raws) compared with 1,590,000 metric tons in 1925-26 and 1,570,000 metric tons in 1924-25. For the whole of Europe, including Russia, the production of raw sugar is estimated at about 7,342,000 tons, whereas in the two previous campaigns it amounted to 7,471,000 and 7,080,000 tons respectively. The decline is explained by the limitation in the beet sowings in Czecho-Slovakia, where the yield of raw sugar is expected to amount to only 1,200,000 tons this season, as against 1,490,000 tons in 1925-26.

At a recent meeting of beetroot growers in Germany the demand was formulated that the growing of beets should be raised in extent to the level of pre-war times, which would result in a surplus production of about 600,000 tons ; and for the sale of this quantity freedom to export to foreign markets was demanded. The putting forward of such a policy at the present time is, however, considered unwise, especially in view of the fact that a similar attempt in Czecho-Slovakia has failed. For any plans to dump German sugar to succeed, the doubling of the sugar tax, which since September 1925 has amounted to 10 marks per 100 kilograms. is considered a preliminary necessity.

Owing to the depression in the Swedish sugar industry following on the withdrawal of Government aid, the Swedish output has been unable to cover the demand for sugar during the current year, and considerable purchases of German sugar, totalling some 25,000 tons of raw sugar, have been made by the Swedish Sugar Company, to be melted in their refineries.

The Suchar Process.

From a statement that recently appeared in the financial press we learn that arrangements have been made for a further expansion in the exploitation of the Suchar Process of refining sugar, which has recently aroused much interest in Louisiana, Porto Rico, South Africa, and elsewhere. The rights of the Process for the United Kingdom, British West Indies, Egypt, China, Japan, Formosa, India, etc., have been secured by an English Company, "British Suchar Processes Limited," of 21, Old Broad Street, London, E.C.2, which was registered on the 4th October, 1926. This Company, we gather, has very strong financial backing and is beginning its activities under the best possible auspices.

The results reported by refiners in which the Suchar Process is already installed are considered so promising that it would seem possible to produce a standard refined sugar at the plantation. Moreover, the simplicity of the process and the many economies effected are features which must arouse the interest of all sugar planters. According to reports received, the cost of refining by this process is well below that of the bonechar one, while the quality of the sugar produced, if one may judge from shipments made from Porto Rico and Louisiana, is compared favourably with the best on the market.

As far as the sugar planter is concerned, the most attractive features claimed for the Suchar Process are the relatively small capital investment required, and the low water and fuel consumption. Moreover, the claim of the inventors that the carbon can be simply and completely reactivated after use, appears to be fully substantiated.

In addition to its use in the raw sugar factory, Suchar is finding an application in the syrup, jam, and confectionery industries, as it enables the manufacturer to produce directly, from raw sugar, syrups which will conform to any specific requirements.

Fifty Years Ago.

From the "Sugar Cane," November, 1876.

A paper which had been read before the British Association by the late T. L. Patterson, a well known and well respected Greenock technologist, dealing with the history of the Clyde sugar industry was reprinted in this issue of our predecessor. It directed attention to the technical improvements which had been made, the early history of the industry being outlined, and the value of various inventions which had been introduced being indicated. Extracts from his interesting notes on the very early history of the industry, would seem to be worth reproduction here.

"At the beginning of the present century, and for long prior thereto, the ordinary process of refining . . . . . consisted in dissolving the sugar in water to a specific gravity of about 1·25 (29·2° Bé., or 54° Brix), and adding a little milk-of-lime to neutralize any acidity which might be present in the raw material. From half to one per cent. of blood was then added, and the temperature raised by means of an open fire to the boiling point. The coagulum which rose to the surface, containing much of the insoluble impurities, was then skimmed off. Without the use of blood, the filtration would have been very tedious and difficult. The solution was next run on to filters, which consisted of blankets stretched over the mouths of open cisterns, through which the liquid percolated comparatively clear. The filtrate was concentrated in pans over an open fire, and when near the granulating point—which was known by withdrawing a small portion on the end of a stick and blowing thereon--it was run into another vessel where it was cooled by stirring with paddles until sufficient grain was formed. It was then ladled into conical moulds, and set aside with the apex downwards, to complete the granulation. On standing over-night, a hole in the bottom of the mould was opened, and the syrup or mother-liquor allowed to drain into other vessels to be again concentrated and passed through a similar process. The contents of the moulds were purified and decolorized by repeated additions of half an inch of very moist pipeclay, placed on the bases of the moulds, from which the water gradually percolated down through the sugar driving the syrup before it, until after the last treatment the sugar was judged to be pure. When the moulds had remained for a time to drain off the last portions of syrup, the contents were removed and placed on a table, base downwards, to allow the remaining syrup to diffuse uniformly throughout the mass. It was then placed in a drying stove for three or four days, after which the tips were carefully rounded off in a revolving knife machine and sent into consumption as loaf sugar. The syrup obtained from the foregoing process yielded products of an intermediate quality, called pieces. The syrup from the pieces was boiled up and set aside for three or four weeks to granulate in large moulds, similar in shape to those above described, but holding from two to three cwt. Holes in the bottom were afterwards opened so that the viscid dark-coloured treacle might drain from the dark coloured sticky sugar, known as bastards, which remained in the moulds." Such was the process of sugar refining about the time when Howard introduced his vacuum pan, the installation of which became general in Greenock refineries about 1822. Char was not introduced until some years after the patents granted to Derosne (1830), Pertins (also 1830), and Parker (1831), as refiners had yet to learn how to manipulate it in large quantities, to revivify it economically, and to overcome the working of the large volume of water required to wash it. Bag filters were introduced in 1824 by Cleland to be afterwards much improved by Taylor. It would probably be about 1850 that Clyde refiners took up the centrifugal machine.

Experimental Work in British Guiana.

The Annual Report[1] of the new Experiment Sugar Station in British Guiana contains a good deal of interesting matter. Inevitably, there has been much preliminary work to be got through, and it is evident that the station has suffered greatly through the continuous illness of the Manager and a consequent shuffling and re-shuffling of the staff; while very considerable alterations and additions have had to be made in the chemical laboratory, to cope with the new demands made upon it. With the death of Sir JOHN HARRISON, who has for many years done such distinguished service to the sugar industry and to the Colony as a whole, matters have not been made easier; but the Superintendent of the Experiment Station, Mr. CYRIL WHITTLES, has apparently started his work with enthusiasm, and presents a very interesting report. The two limiting factors in Demerara sugar cane growing are drainage and the labour supply; and both of these receive very considerable attention. As the whole of the estate work depends on these factors, the present article will be mainly devoted to a discussion of what the Superintendent has to say on water level and labour saving.

The first subject dealt with in the Report, and the most important for Demerara, is the relation between the rainfall and the level of the water table, and this is illustrated by a diagram for the year from October, 1924 to September, 1925. The rainfall is shown by dots at various heights, week by week throughout the year, and the same applies to the distance of the water level below the surface of the fields in the Cummings Canal, and, during the latter part of the year, in the manurial plots. The months are placed below the diagram in order, but, as they cannot correspond with the weekly dots, the exact dates of the various phenomena are left in doubt without the use of a calendar. This uncertainty, which is sometimes of importance, could be got over by the use of squared paper for the diagram or some modification of it. The rainfall appears to have been in excess during weeks in October (3 in.); December (3 in. and over 4 in.); March (over 10 in.); and towards the end of June (5 in.); while, after April, individual weeks recorded from 2 in. to 3 in. in each month.

The level of water in the canal followed these rainfalls closely. In the rainy weeks of October and December, it approached to within a foot of the surface of the cane fields, in March to within a few inches, and thereafter to within 18 inches in each month, and under one foot in individual weeks in August and September. The effect of drainage was seen in the manurial plots, where the water level was about 2½ ft. down in April and May, rising to about 2 ft. in August and falling again in September. An ingenious device for checking the height of the water table was given a trial in these plots. "This consisted of a small well about a foot in diameter and six feet deep. A loaded float was attached to one end of a light brass chain which passed over a pulley mounted on a suitable upright, the other end of the chain carrying a counterpoise. This load and counterpoise served to reduce the error caused by the chain itself. A pointer attached to the counterpoise gave the depth of the water level below the surface of the ground on a suitably graduated scale. Readings were taken daily after the 1st of April, 1925, and the weekly levels are shown in the diagram. It is regretted that readings are not available for the wet period in March, when the water rose to within 9 in. of the surface."

These observations throw very considerable light upon the difficulties encountered in cultivating the sugar cane in Demerara. WHITTLES considers that the water logged condition of the fields is largely responsible for the very small differences noted in the manurial experimental plots ; and points out that Harrison attributed the insignificance of liming experiments to the same cause. In heavy clay soils of this type, a water table two feet down gives only nine inches to one foot for the cane to grow in. He suggests that it would be of great interest, and possibly of moment, if Harrison's extremely valuable experiments could be repeated on well drained land ; but, if the chart represents the general condition of the cane fields of the tract, such a repetition would be of little practical use, unless a better drainage system were found on the estates.

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[1] Annual Report of the British Guiana Sugar Planters' Experiment Station, October 1924 to September, 1925. C. L. WHITTLES and A. D. ELMSLY LAUCHLAN. *Daily Chronicle Press*, Georgetown.

The course of the drainage water from the experiment station fields is traced, and the author points out that the exit is at present over-loaded in rainy weather. A solution might be obtained by the installation of a pumping plant to keep the discharge at a reasonable level, with the dual advantage of improving the soil conditions of a large residential area, and greatly benefiting the experiment station. Drainage is obviously a limiting factor in cane cultivation in the Colony, and especially as affecting manurial and other experiments. A second well known factor is, of course, the scarcity of labour ; and these two problems have evidently greatly exercised the author's mind. The system of open drains, which is universal on the estates, presents one of the greatest hindrances to the introduction of intertillage between the rows, so important in such soils, by labour saving machines. Building upon his experience in Assam tea plantations, in another part of the report he attacks the problem of under-drainage, so as to leave the surface free for improved implements.

In Assam a system of covered drains has been found satisfactory, and cheap because of low priced labour. The following are the details : a trench is dug, one foot wide and two feet deep, and at the bottom of this a second trench is dug, six inches wide and again two feet deep : a strip of bamboo matting is then laid along the base of the first trench, so as to form a roof for the lower, narrower trench : the subsoil obtained from the lower trench is placed on the top of the matting and well tamped by treading, and the whole is filled in again, leaving a level surface. Such underground drains have been found in serviceable condition after ten years, in a country where the rainfall is 100 to 110 inches, all falling during four months of the year. A first trial of this method was made during the year ; and, although the filling in of the earth was not done rapidly enough to prevent cracking of the soil, a distinct gain was experienced in the crops grown. The cost was however prohibitive, with the local labour. A mechanical implement called the " volt excavator " is accordingly suggested and described, which gets through the work much more expeditously and cheaply. The following is the printed description : " The U-shaped share serves to scoop up a layer of the soil ; the loosened soil enters the lower part of the inclined conveyor that carries it to the top of the machine where a discharge chute returns it to the ground on the side of the trench. An adjustable shoe in front regulates the depth of the cut. The conveyor is driven direct by a combined cog and carrying wheel that runs along the bottom of the ditch. It is understood that near Boston, Lincolnshire, working in light loamy soils the machine with a Fordson tractor will cut 100 yards, three feet deep, in half an hour." The author states that the rate of working in wet clay is not appreciably reduced. This implement has been already used in Demerara, but was considered too light and flimsy ; and a new and heavier model has been designed and is being made. It is suggested that, as the cut is only 6 in. deep, several machines should work in tandem, drawn by the same power. It will be interesting to learn the future behaviour of these excavators,as they may be of value wherever drainage is needed.

Bamboo matting is also expensive locally, and the author suggests the use of rough tiles, such as could easily be prepared from the heavy clay around ; and it is recommended that, with a rainfall of 80 to 100 inches they should be at least 8 inches across. The narrow trench two feet deep would roughly be equivalent to a circular drain 18 inches in diameter. " Drains of the ' cut and cover ' type constructed in the forties in peat are still giving satisfactory service, after 80 years. Here the cover was made from dried peat turves which were well rammed. A similar type of drain might prove satisfactory on pegasse soils."

Then follow references to certain rather mysterious implements called respectively the " rototiller " and the " jackpan." The former has been used on estates in the colony for intertillage between the rows on land with shallow drains ; and appears to be doing very satisfactory work, developing very good tilth, " such as could only be obtained, with any other implements on the heavy clay of Sophia, by a long series of tillage operations which would have to be carried out under optimum weather conditions." One planter is mentioned as having obtained such good results that he ordered three more machines. The rototiller, being light, was easily moved from bed to bed by means of light wooden bridges ; and even with this additional expense the cost of cultivation was reduced to a very small fraction of that entailed by hand labour. But this reduction in the cost of labour was considered of much less importance than the very great improvement in the tilth obtained.

The Jackpan appears to be a new hand implement which requires some practice before using. It will be sufficient to give the official description of it till it has been more fully tried : " The Jackpan is not unlike a pick with a long handle and one blade which at the end broadens and flattens out into a chisel-like edge. The second blade is replaced by a wide, pear-shaped disc. In use as a pan breaker or cultivator the Jackpan is driven into the ground like a pick. So great is its penetration, thanks to the scientific design, that only in the very hardest soil is more than one blow required to bury the blade. An upward pull on the handle causes the blade to rotate round the fulcrum formed by the disc, thus shattering the surrounding soil in a way that must be seen to be fully appreciated." This description suggests that it must be rather tiring, in a hot climate, to use the Jackpan.

Various experiments were carried out during the year on the manurial plots : the effect of a mulch of rice straw on the yield of cane, a comparison of ammonium sulphate and nitrate of soda, the optimum rate of application of the former, the effect of potash and superphosphate, both separately and together, and comparisons of various canes of local interest. The available information on *Sesbania aculeata, Crotalaria striata,* and *Vigna repens,* as green manuring plants, is summarized; the possible presence of mosaic disease in a certain crop is discussed, and spacing experiments are described. Appended to the Superintendent's Report, is that of the work in the Laboratory, by A. D. E. Lauchlan, the newly appointed chemist to the station. It will not be possible here to deal with these ; and, with the unsatisfactory nature of the soil, it is doubtful whether the results obtained would be of more than local interest.

C.A.B.

The sugar industry in Dutch Guiana is represented by four plantations, of which two are British owned and managed. The output of 1925 was 16,612 tons, as compared with 9068 tons in 1924 and 11,785 tons in 1923.

Eye Spot Disease on the Sugar Cane in Hawaii.

Before entering on the subject of this paper, a few preliminary remarks on fungus diseases in plants may be of use to some of the readers of this Journal. When we come to the study of sugar cane diseases, we find that almost all of them are caused by the attacks of excessively minute organisms, the great bulk consisting of loose accumulations of almost invisible threads, called the hyphae of fungi, heaped together much as the particles composing a tobacco mixture. It is typical of these fungi that many separate units enter into the complex, and they grow in large numbers together ; their onslaught is therefore usually a mass attack by a multitude of organisms. Even a mushroom, which we are accustomed to think of as an individual, is often really a communal structure, built up of a great number of individuals for the common purpose of propagation. Now, in spite of the extreme simplicity of their structure, different fungi exhibit an extraordinary amount of individuality as to their likes and dislikes. We call the fungi causing diseases parasites, and the plants attacked their hosts ; and the reason of the preference shown by particular fungi for special hosts is one of the problems which have not as yet been solved. Often a species or variety of fungus will be found exclusively on certain kinds of plants, and not infrequently on one only. A classical example is that of the fungus causing rust in wheat. It was found on investigation that, while spending one portion of its existence in the wheat leaves, another phase of its life history was gone through in those of the common barberry of the hedges ; a discovery which led to a wholesale destruction of the latter plant near to wheat fields.

In nature, plants of one kind are usually widely scattered, and until we knew the method of propagation of the minute fungi causing disease, it was always a puzzle as to how they managed to reach their appropriate hosts. The solution of the puzzle lies in the enormous number of spores, or seed-like bodies, produced, and their microscropic size. Incidentally, this also applies to the various higher plants which live as partial parasites on the roots of the sugar cane : *Alectra brasiliensis* in the West Indies (sometimes called the " cane killer "), *Striga lutea* in India, and *Aeginetia indica* in the Philippines. In all of these the seeds are excessively minute and produced in very large numbers. The spores of fungi are compact little bodies, entirely invisible to the naked eye, and are formed in such quantities that practically the whole of the air and soil in the neighbourhood is filled with them—just as in the case of the pollen in a pine wood, which floats in the air, and has been captured on a slip of glass smeared with glycerine miles away from any pine tree. Some of the spores are very delicate and dry up quickly ; but others have a hard, waterproof coat, and can remain quiescent and unharmed for months, even during the hot dry season in the tropics. In nature, then, ample means are at the disposal of the parasite to find its host. But, when we cultivate a plant in the field, we grow it usually in great masses to the exclusion of all other kinds. A solitary spore alighting in a cane field may start the ball rolling, and in a few weeks may produce hundreds or thousands of further spores, all of which may hit their mark, and in favourable conditions permeate the entire neighbourhood in a short time.

Spots on cane leaves are caused by the bites of insects or, more frequently, by the settling and growth of fungus spores. The insect injuries remain more or less localized, but, once a spore has succeeded in driving a germinating hypha through the hard outer wall of the leaf, this hypha may grow to form a sore place many inches in length, leaving dead or damaged tissue in its wake, and changing the colour of the leaf from a bright green to a dull yellow or brown, owing to the death of the cells attacked in its interior. Leaf spot diseases are common on the cane in many countries, but are usually considered of little moment. This is probably a mistake, for the area of leaf surface stands in close relation to the weight of cane reaped at harvest, and any leaf spot attack, to be noticeable, must deprive the plant of a fair proportion of its weight-forming organ.

Eye spot is the name given to such a disease met with in the Hawaiian cane fields, and it is caused by a fungus called *Helminthosporium Sacchari*, Butler. It is no new thing there, for it is mentioned in the Report of the Experiment Stations for 1918-1919, where attention is drawn to it, as causing misgiving because of its marked preference for H 109. Instances are given in which during the seasons 1917 and 1918, certain plots of this cane were so badly attacked that the crop was considered an entire failure.[1] Recently, the disease has received a good deal of attention, and two interesting papers have just been read before the Association of Hawaiian Technologists: the first by H. A. Lee, the mycologist, giving a complete study of the disease, and the second by J. P. Martin and N. S. Deverill, describing a method of testing large batches of seedlings at the same time and in a short period as to their susceptibility while still quite young.[2] Some of the more important details of the former paper are appended, and the latter is briefly referred to.

According to Lee, the disease has been noted in the following countries: India, Cuba, Hawaii, San Domingo, Barbados, Trinidad, Porto Rico, Jamaica, Java and Réunion. In most of these it is considered to be merely a minor matter, probably because the varieties grown are resistant to the disease; in Hawaii, of the standard varieties, H 109 and Lahaina are the only ones which are injured by it to any appreciable extent. There are many spots on the leaves of the cane, and it is therefore important for those growing it to be able to diagnose eye spot correctly, and the following detailed description is accordingly given. In young leaves, where the infection is one to three days old, the spots are small, watery, dark green, elongated, and scarcely to be distinguished from the normal green colour of the leaf. When three to five days old, they are pale yellow or straw coloured, oval, visible on both sides of the leaf, and from one quarter to three-eighths of an inch long. In from five to ten days, large yellow areas are formed with ova centres of reddish brown, and later on, if the conditions are favourable to the fungus, the discoloration in H 109 spreads as a longitidunal streak, turning reddish-brown. As these streaks become more numerous and larger, the leaves turn brown and die; and the field presents the appearance of having been blasted or scorched. If the terminal shoot is affected so as to develop top rot, the whole cane is often killed. Once the spore, lying on the surface, has germinated and the hypha produced has entered into the leaf, a second crop of spores may be formed in 8 to 15 days.

Moisture on the leaves has been found to increase eye spot. Dew or fine rain is very favourable to germination, while heavy showers appear rather to wash the spores away. The hours of dew are not easy to measure, as they occur at night; but Lee considers that they may be roughly determined by the humidity recorders; and such being the case, he has noted a distinct correlation between the length of the dew period and the severity of the attack. The usual brisk trade winds check eye spot, while still, moist weather assists it in its spread. Fungus spores of many kinds are checked or even killed by direct sunlight, but those of eye spot do not appear to suffer materially from this cause; but the sun, of course, evaporates the moisture on the leaf surface, and this is of indirect use. And it is pointed out that sunlight acts in another direction, namely by heating up the interior of the leaf. It has been noted that the fungus cannot grow at a temperature above 96°F.; and, although this temperature is rarely if ever reached in the cane fields of Hawaii, the interior of the leaves may be, in direct sunlight, heated up to 35° further (i.e. 131°F.); such a temperature would surely help to destroy the hyphae, and would at any rate render the fungus powerless for the time being to do any harm. These data enable us to explain the fact that a definite check is given to the spread of eye spot during the spring and summer, while it is encouraged during the shorter, colder days of winter. The spores, however, are very resistant to drying up; and can lie inactive and unhurt throughout the summer months.

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[1] *I.S.J.*, 1920, p. 139.

[2] Eye Spot Disease. H. Atherton Lee. Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October, 1926. Resistance of Young Potted Sugar Cane Seedlings to Eye Spot Disease. J. P. Martin and N. S. Deverill. *Ibid.*

Luxuriant growth of the cane favours the fungus in its attacks on the young leaves and, therefore, all action inducing this should be very carefully regulated. The application of nitrogenous manures is followed by rapid growth, and the author therefore recommends that this stimulant should only be applied during the drier spring and summer months, when other factors check the spread of the disease. As filter press induces a continuous condition of luxuriance, it should be kept away from all areas in which eye spot is thought likely to appear. So with watering the canes in winter: here it is recommended that the intervals between the irrigations should be gradually increased, so as to reduce the humidity attendant on this practice. The nearness of water-logged ground has shown itself to favour eye spot, and efficient drainage should be attended to in such places. Again, it is rare for severe attacks to appear on light, sandy soils; whereas on heavy clays and even good loams the attacks are often severe, doubtless owing to the gradual evaporation of water from such water-holding soils. It is unfortunate that these are just the conditions for maximum yields under H 109; but it is better to have a good crop from some more resistant variety than to have a badly attacked growth of H 109, especially as the latter would provide a centre of infection for the whole of the neighbourhood. Severe attacks of leaf sucking insects appear to show a correlation with outbreaks of eye spot, as has been observed in the case of leaf hopper.

As to direct offensive measures against the fungus, the use of liquid sprays is out of the question, because of the mode of growth of the crop; besides which, the application of Bordeaux mixture showed no advantage in the experiments. But of late years dusting with fine powders has frequently proved of use in checking leaf diseases. Dusting with powdered sulphur was successful, and this method shows distinct promise. Eight applications, at fortnightly intervals, are claimed to have reduced infection by 27 per cent. in comparative plots. But, from results obtained with other crops, it is considered probable that more frequent doses would be well worth the while, if possible as often as once a week: this might prevent the entry of germinated spores, for instance. The total cost of 12 applications of sulphur dust is estimated at $12·50 per acre. Dusting by aeroplane has been explored, and it is stated by airmen that it would be quite feasible. Other methods suggested and tried are: firing the plot, cutting out the canes, and removing the diseased leaves. Of these the first alone is approved by the author, because of the danger of spreading the spores of the fungus by either of the other. One experiment of burning is reported, as having been successfully carried out, without the fire passing to the neighbouring canes. It is furthermore stated that, owing to subsequent growth, little loss was sustained in weight of canes at harvest. But the character of the juice was unfortunately not determined ; a matter of importance, in that in other cases burning has been found to cause deterioriation.

A comprehensive series of tests, by spraying the young leaves of different varieties with a watery infusion containing spores of the fungus and counting the infections in comparison with H 109, have shown that the cane varieties being grown in Hawaii vary a great deal in their resistant powers. Denoting H 109 as 1000, the following varieties gave results under 250 : POJ 213, 234, 979, Yellow Caledonia, Badila, Uba, and POJ 36, Yellow Tip, D 1135 and various local seedlings, the first seven being under 100. These include all the Hawaiian canes known outside the islands, excepting Lahaina, placed in the 500-750 section. Inoculation of the grasses common in the cane fields was uniformly without effect. Thus, of standard varieties, Yellow Caledonia and Badila are highly resistant, and it is suggested that, although their yield would be inferior to that of H 109 (if healthy), they might be used when it is thought desirable to eliminate bad spots in fields, and thus remove important sources of infection.

Much loss is undoubtedly caused by the restriction of feeding area in the leaves by eye spot ; but it is stated by the author, that the subsequent injury to the cane by top rot is the chief cause of loss at harvest time. A few spots on the leaves may be neglected, but 20 to 30 per leaf, with long streaks of dead tissue, are sufficient to reduce the thickness of the canes and shorten the joints. If top rot follows, the upper buds will shoot out, with a reduction of the sugar in the juice. Small areas have been met with, in which 80 per cent. of the canes have died from top rot. Various data are available as to the extent of loss incurred, but the most complete are those obtained by the analysis of a series of cart loads of canes at Kilauea : the results are given in a table. It will suffice here to give one of the items in this table, namely, the amount of sugar per cane, when healthy and attacked by top rot. 1200 healthy canes gave 0·57 sugar per cane, as against 0·17 in 400 with dead tops. Again, 400 healthy canes gave 0·60 sugar per cane, against 0·31 in 200 with tops partly dead. To this loss in the proportion of sugar the decrease in weight of the injured canes must be added.

The acreages of H 109 infected by eye spot are given as 3·3 per cent. in 1926 and 4·4 per cent. in 1927. It is pointed out that this increase in the disease is in spite of the fact, that last winter was regarded as unfavourable to eye spot ; and the general increase taking place in the area under H 109 is a cause for misgiving. Although eye spot is perhaps of no great significance to the industry as a whole, it is becoming a very serious matter for individual planters.

Martin and Deverill point out that a large number of seedlings are raised every year in Hawaii with the object of producing new crop canes which are, among other things, highly resistant to eye spot. These are planted in small batches, usually 2-4 feet apart, among the canes growing on badly infected fields, sometimes to the extent of 8000 to 14,000 in one plantation. At the end of the season, the strong growing seedlings, free from eye spot, are selected for further trials. This certainly appears to be very praiseworthy, but the authors are perfectly correct in assuming that the information could be obtained more rapidly and with less expenditure of time and labour. Furthermore, the experiments are conducted in the most fertile parts of the plantation, and the locking up of valuable land for the purpose is uneconomic, because of the poor yield in sugar of the bulk of the tested seedlings.

They accordingly set about a simpler way of testing the resistance of the new seedlings. The scheme prepared was to group young seedlings, three to four months old and still in pots, on a staging, and spraying them with an infusion of water with spores to the extent of from 20 to 40 per drop, under conditions made as favourable as possible for the germination and growth of the fungus. For the latter purpose, an awning was placed above the seedlings of three layers of white cloth, and this was kept constantly moist so as to produce a humid atmosphere, at the same time giving the young leaves a very fine water spray to keep them damp, but without permitting any drops to collect. All direct sun heat was kept off by the awning, and the constant evaporation of water kept the temperature from rising inside the leaves. The spore infusion was sprayed upon the young leaves three times during the first day of the experiment, at three-hour intervals, and the total period of treatment before the results were collected was about a fortnight.

A Table gives the results obtained at the end of a fortnight, according to the parentage of the seedlings. Giving only the totals, out of 433 seedlings tested, 55 were already dead, 106 proved to be very susceptible, 57 slightly susceptible, 153 resistant and 35 very resistant. The period of testing may appear to be short. It must be remembered that cane seedlings need bright sunlight for their proper development, but to be kept in the moist shade for so short a period could not well be held accountable for such significant results. At the end of 36 hours infected spots began to appear, and the disease developed rapidly throughout, and severely injured large numbers of seedlings. On the results of this experiment, the authors claim that, by this method, 37 per cent. of the seedlings could be discarded at once, and probably 57 per cent. before the time for planting them out. The number planted in the estate fields would be greatly reduced, with a proportionate saving of land, labour and trouble ; and, at the same time, with a considerably greater probability of obtaining resistant seedlings for the further trials as to richness of juice and suitability to the local conditions.

C. A. B.

In consequence of competition from imported sugars, the prices in South Africa of Natal White sugars have been reduced recently by £1 per ton all round. The competitive imports have included Cuban sugar, 12,000 bags having been received at Durban on one recent occasion, at a price said to be ½d. per lb. below that of the local product. This dumping of Cuban sugar at a price below that at which inferior local grades are ordinarily sold has aroused some attention ; but the South African Government have refused so far to put into operation the dumping law.

Sir **Arthur** E. **Shipley**, F.R.S., writing on bookbinding for the tropics,[1] refers to the following preparation used in Porto Rico, this being said to afford protection from termites for a year or more : 1 oz. corrosive sublimate, 1 oz. of carbolic acid, and 1 quart of alcohol: whilst in Cuba it is reported that books brushed lightly over the covers with a mixture containing 1000 c.c. of methylated spirit, 20 grms. of mercury bichloride, and 25 c.c. of carbolic acid, adding sufficient shellac to produce a slightly adhesive liquid is an effective preservative against insect attack. Sir **Arthur** suggests that it may be found advisable to use binders made of asbestos as covers, bound together by metal, either spring or clips. But the question of preserving books in the tropics requires evidently further investigation in order to arrive at a more satisfactory solution.

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[1] *Tropical Agriculture*, 1926, 3, No. 7, 141-142.

The Cultivation of Sugar Cane in Peru.

By ARTHUR H. ROSENFELD.[1]

At present the entire sugar industry of Peru is confined to the so-called coastal "valleys," situated in the deltas of the various short rivers which find their way from the high Andean slopes to the Pacific. The main sugar "valleys" are fourteen in number. Chicama and Santa Catalina, in the northern department of La Libertad, are so close together that they might be taken as one, particularly as they ship from the same port of Salaverry, even though they do irrigate from distinct rivers.

The Andes, running the entire length of the country from north to south and rising abruptly from the coast, form an obstacle to the clouds moving in a westerly direction from the hinterlands of the east, which results in an abundant precipitation on that side, that finds its way to the Atlantic Ocean through the Amazon and its tributaries, while the lower western slope and the coastal plains are left with an almost complete absence of rainfall in normal years. The heavy rainfall of 1925 all along the lower western slope of the Andes and the coastal plains was but the repetition of a peculiar climatic phenomenon which seems to occur every thirty to thirty-five years and is probably due to erratic changes in the cold Humboldt current.

Despite the fact that the entire sugar area is located well within the tropics, it has in no sense a typically tropical climate, due to the effects of this cold Humboldt current flowing from the South Pole along the entire coast line, which so reduces the temperature that the entire region may be considered as subtropical. Although this might appear to be disadvantageous, the fact that the application of water can be entirely controlled by the agriculturist and that the cane can be artificially ripened by withholding the water at the proper time makes the Peruvian districts extremely favourable for large yields of a product of very high industrial value. For a more detailed discussion of the climate of Peru and of some of the phenomena responsible for it, the reader is referred to the author's report on an economic survey of the cotton industry of that country, submitted to the Tropical Plant Research Foundation of Washington, D.C., upon his return from Peru in the middle of 1926.

As the coastal "valleys," which are in reality such parts of the otherwise desert pampas as can be reached by the irrigation water from the various rivers, all slope from the Andes to the sea, they have just the proper incline to permit of irrigation by gravity from the rivers. Most of the irrigation works employed in these valleys were established by the ancient Incas or their predecessors, and are so simple, efficient, economical and complete that they are still marvels to irrigation engineers from other parts of the world where irrigation calls for complicated systems and very expensive installations. Also, the Peruvian coastal agriculturists down to the last peon have been reared under a system of irrigation agriculture and their management of water is a model of simplicity and efficiency.

SOILS.

The soils of all of the coastal valleys of Peru are of alluvial origin, formed around the deltas of the various rivers, which have brought down silt from above, and possess all the well known advantages of this general type. They are generally quite deep, of excellent texture, and possess good natural drainage, due to the fact that most of them are superimposed on permeable strata of sand or gravel. In cases where the subsoil formation is not of a porous nature, the natural fall of the land to the sea makes artificial drainage a problem of easy solution. The soils are in general very easy to work and their physical condition, when agricultural work is difficult, can always be improved by intelligent application of irrigation water. This advantage of easy and cheap drainage and of usually abundant supplies of water also goes far towards solving the alkali problem.

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[1] Technical Adviser to the American Sugar Cane League, Special Representative of the Tropical Plant Research Foundation and ex-Director of the Tucumán Agricultural Experiment Station.

Naturally, the physical and chemical composition of these soils will vary with the nature of the rocks over which the streams forming them have flowed and the fall of the rivers and the lands which have been formed by them. The proportions of sand and clay are quite variable in the different valleys and the cohesion and permeability of the soils will vary accordingly. All classes of soils occur in the several valleys, from compact and humid lands of almost pure clay through loams and sandy loams to almost pure sand. In the upper parts of the valleys, which are usually and quite naturally the narrowest parts as well, are generally found the more gravelly or stony types of soil, while the more alkaline ones are found in the lower parts, due to their less efficient natural drainage and to the accumulation of alkaline salts in the filtration waters. The depth of the soil is very variable indeed, but is generally greatest in the lower parts of the valleys, where at times the top soil is many feet in thickness.

The subsoils are also very variable in their physical and chemical composition, the stony, gravelly or sandy subsoils showing well drained and porous soils above them, whereas the more impermeable subsoils, above all in the case of shallow soils, will generally show the more humid types of soils superimposed upon them.

As to the chemical composition of the various types of soils, the reader is referred to the author's report on the sugar industry of Peru submitted to the Tropical Plant Research Foundation.

IRRIGATION.

The rivers of the coastal region do not bring down more than a small percentage of the water necessary for the irrigation of the available agricultural soils. There is at least ten times the present area of cultivable land of excellent quality that is unproductive only on account of the lack of water with which to produce crops upon it. That these now desert lands are perfectly capable of producing crops is evident from the fact that with each small rainfall in certain northern valleys, or even with nothing more than the humidity produced by the mists so characteristic of the winter season in all the coastal area, they are covered with an abundant vegetative growth which supports large numbers of cattle, goats and hogs during these periods. Some experiments have been carried out on these so-called " loams " to determine the feasibility of dry farming. Hundreds of thousands of fertile acres but await the genius of the engineer to make them highly productive, and the Peruvian Government has of late years undertaken several large irrigation projects, the most notable amongst these being the recently completed Imperial Project in the Canete Valley and the Olmos Project in the northern department of Lambayeque, the latter a really colossal undertaking under the charge of Mr. C. W. SUTTON, an engineer from the United States who heads the Peruvian irrigation service. This project is discussed in detail in the aforementioned report of the writer on an economic survey of the Peruvian cotton industry.

The river flow along the coast is, naturally, quite variable and this of course seriously complicates agricultural operations. In the summer, due to the heavy rainfall above, the rivers bring down enormous quantities of water, but in the winter many of them become completely dry and, with a crop having to remain on the ground so long a time as does sugar cane in Peru, the cultivable area must necessarily be calculated more nearly in accordance with the minimum flow than with the maximum, when the larger part of the valuable water must flow into the sea unused.

In recent years considerable investigation of the underground water resources of some of the northern cane valleys has been carried on, particularly in the most important Valley of Chicama. An interesting development along this line has been the construction of wells with long filtering galleries to catch the currents of water flowing over the impermeable subsoils already mentioned, and at present in Central Cartavio additional shafts are being sunk within such galleries in order to tap the water pushed up by the pressure from below. Important increases in well flow have already been obtained both through the use of these filtering galleries and through the deeper shafts within these. If the permanent supply of irrigation water in the Chicama and other valleys can be considerably increased by these systems, a great step forward will have been taken. Naturally this water must be pumped and is, therefore, more expensive than the water from the rivers, which is distributed entirely by gravity, but when it is considered that it is employed only in the months of genuine scarcity, and would then serve to keep the cane growing when otherwise it would be receiving a distinct setback in its development which is seldom entirely overcome by the return of normal moisture conditions, the extreme value of such a supplementary irrigation supply can readily be appreciated. In fact, there are undoubtedly certain seasons where such installations would entirely pay for themselves in one crop by supplying the necessary water just at the time when its availability might signify the difference between a good crop and a near failure, while in many instances an increase in the permanent available water supply may mean that considerable hitherto unproductive land of good quality may be put under the plough.

It is a fortunate coincidence that abundant water and high temperatures come at the same time of the year, thus permitting an extremely rapid development of the cane during the summer months. The quantity of water applied to the canefields varies with the location of the valley, the type of soil, the time of the year, and the age of the cane. Each field has running along the highest part of it what is known as the " acequia madre " or mother ditch, and from this radiate the secondary canals which carry the water to the various smaller fields, called " cuarteles," and from which the water is drawn down the rows or middles. The excess water from the furrows is collected at the lower end and re-used for " cuarteles " at a lower level.

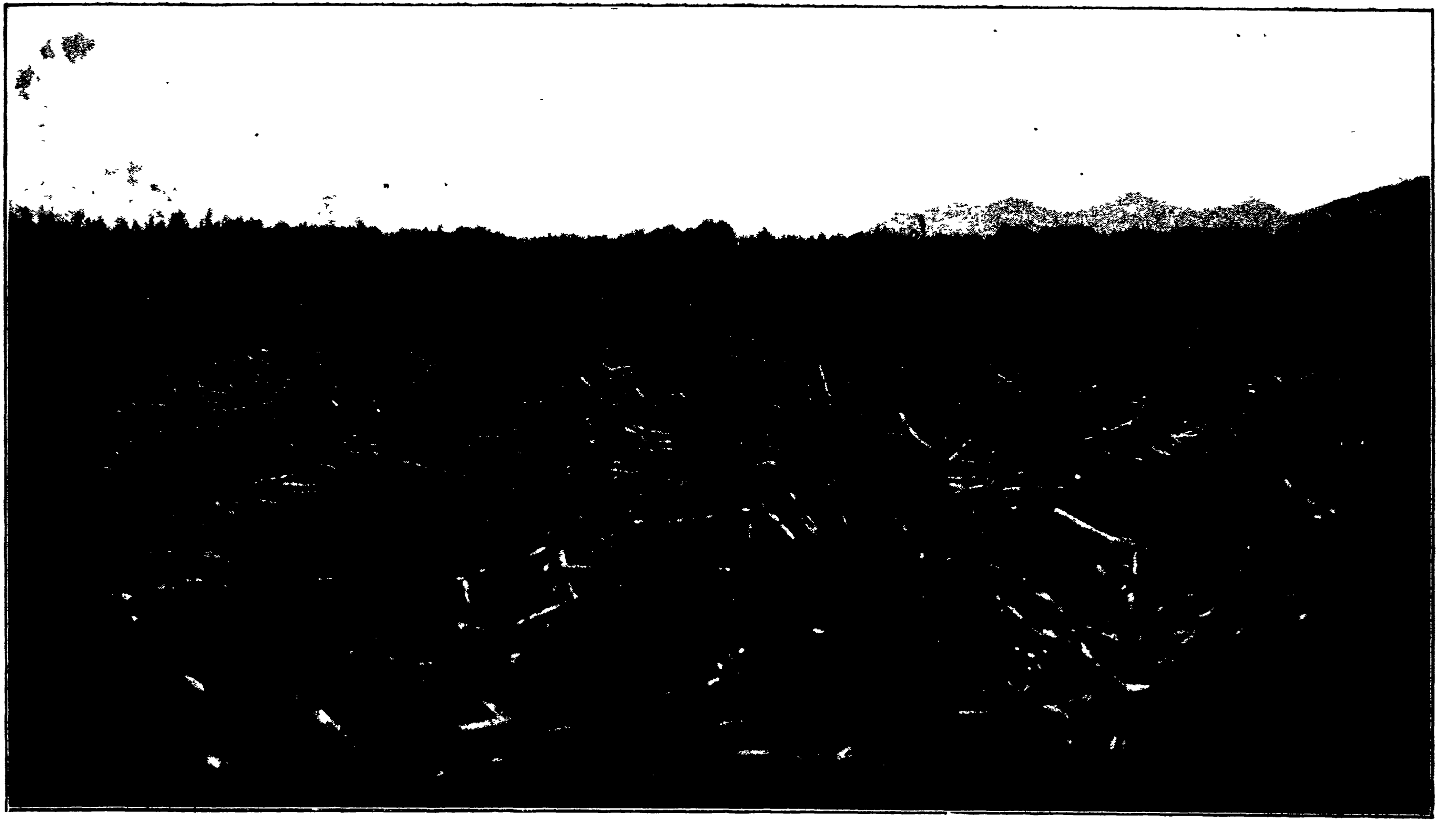
The Peruvian agriculturists are so remarkably efficient, both in the laying out of irrigation ditches and in the management of the water, that the water from one of these main ditches will be employed for irrigating remarkably large areas of land almost without human attention. The number of peons employed for irrigating astonishingly large areas is so small that it surprises persons accustomed to more complicated systems of irrigation.

Irrigations are, naturally, most frequent during the summer months, when evaporation is highest and the development of the cane most rapid. It is a difficult matter to arrive at the amount of water applied per acre at any time or place, since on no plantation visited by the author was any

Cultivation of Sugar Cane in Peru.

I Covering Guano and throwing First Dirt to Cane

II Off barring and distributing Guano, using Fordson Tractor



III. A Fine Yield of Bourbon Cane in a Peruvian Field, ready for Loading measuring device or weir encountered. In the northern valleys the standard of measurement for the distribution of water in the main irrigation canals is what is called a "riego," which is a unit of 16 litres of water per sec., but no attempt seems to be made to estimate the amount of water applied per field or per acre, it being the custom to irrigate very heavily when water is abundant and there is "toma libre," i.e., when there is no restriction upon the quantity of water taken from the rivers by the various planters or "regadores," and to make the water go just as far as possible when the amount in the river is not sufficient for each irrigator to take from it more than a certain percentage of his allocated share. From data collected in the various valleys and at distinct times of the year, the writer calculates that in the cane valleys an average of around 46,000 gallons of water per acre is used each week. These figures are arrived at after deducting the fields which are in "agoste," or being dried out for from two to four months before crop, and the lands which are being fallowed or replanted.

VARIETIES OF CANE.

In all valleys except that of Tambo, situated at the extreme south of the sugar belt, near the port of Mollendo, the old Bourbon or Otaheite cane, known all over Peru as the Creole cane, is almost exclusively cultivated, there being only occasional small experimental and usually mixed plantings of other varieties introduced into the country many years ago. In the Tambo Valley the Louisiana Striped and Purple (Cheribon) canes are mainly cultivated, although at Chucarapi estate, the property of the Romana family, there is considerable Trinidad 34, which is giving quite excellent results, being a cane of early maturity, high sugar content and low fibre.

The Bourbon cane, which has disappeared in most other countries, is a cane of very high industrial and agricultural value, but adapted mainly to virgin soil conditions, which are still largely maintained in Peru by the splendid preparation of the land and excellent cultivation, as well as by the constant renewal of organic matter through the silt brought down by the irrigation water. Nevertheless, the author considers that Peru is treading on very thin ice indeed in not having other varieties tried out, in order to replace this extremely delicate variety should some of the dangerous diseases which have wiped it out in other countries suddenly make their appearance in Peru. This is one of the matters calling most urgently for the establishment of an experiment station in Peru, and has been gone into in detail by the writer in a project submitted to the National Agrarian Society of Peru.[1]

Besides the varieties mentioned above, the writer during his visits to all of the cane-growing valleys of the country during the first three months of 1926, found small and scattered—and generally mixed—plantings of the following well-known varieties :—

Barbados 208, 376 and 1753, Cristalina, Demerara 95, 117 and 625, Barbados Hybrid 10 (12), Uba, and Yellow Caledonia.. In recent months Messrs. GRACE & Co., owners of Hacienda Cartavio, have introduced H 109 from the Hawaiian Islands.

PREPARATION, PLANTING, CULTIVATION AND HARVEST.

There is probably no country in the world where the preparation of land for sugar cane is on such a high scale of general excellence as in Peru. There are very few small cane growers, outside of the little Valley of Tambo, most of the cane being grown on quite large estates and the greater part of the ploughing is done with Fowler steam ploughing tackle.

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[1] ROSENFELD, ARTHUR H. *La Estación Experimental Agrícola de la Sociedad Nacional Agraria del Perú.* Pp. 1-49. Lima, 1926.

The land is first thoroughly cleaned of all trash and, when renovating an old canefield, even the old stubble is collected and carried out to the headlands, where in many cases it is burned under the boilers of the steam ploughing engines. Three deep ploughings and the corresponding harrowings and cross-harrowings are given, the third harrowing being quite frequently followed by another discing. All this leaves the land like a well spaded garden plot—the most remarkably perfect preparation that the writer has ever encountered. Furrows are then laid off at about 4½ ft., this being quite frequently done with an implement carrying three large "middle busters" attached to a horizontal beam and drawn by the Fowler engines, but is more frequently done with bulls. In the first case the furrows will be from 14 to 16 ins. deep, while in the latter they will usually be 10 to 12. Planting can be carried on in the northern valleys at any time of the year, but October to December plantings seem to give uniformly the best results, as the cane planted in the spring or early summer thus goes through two summers and only one winter before harvest.

In general only tops are used for planting and these almost always from cane which has not been burnt previous to harvesting. The tops will usually run from 18 ins. to 2 ft. in length, varying as to whether the immature green point, called the *vela*, is removed or left on the seed. The manner of inserting the seed and planting before or after irrigation varies considerably in the several valleys and in the different *haciendas* of the same valleys. Mr. COLIN MACDOUGALL, for so many years general manager at Cartavio, in the Chicama Valley, believes in planting in a straight line in the furrow, with the furrow quite dry, inserting the cuttings in the soil at an angle of about 45° and about 10 ins. apart in the row. Boys provided with knee pads made of sacking then *with their hands* draw 2 or 3 ins. of the finely pulverized soil around the cane, leaving a covering so even that it does not interfere with irrigation nor, at the same time, allow the seed to be moved by the water which is applied in small quantity just as soon as the seed is in the ground.

On the huge Gildermeister estate in the same valley, Mr. PEDRO BEHR, the superintendent, generally has the seed cut to lengths of about 2 ft. instead of the 18 ins. usually employed at Cartavio and leaves the *vela* on the seed, whereas Mr. MACDOUGALL believes in removing it. At Casa Grande, the Gildermeister estate and the largest in Peru, the boys insert the seed at the same angle of 45° employed at Cartavio, but the furrows are first filled with water and the seed inserted in this, leaning toward the direction from which the water comes, or *against* the current. The seed is inserted into the ground—or mud—about 6 to 8 ins. and, while spaced some 10 ins. apart, as at Cartavio, is staggered and really planted in two rows some 3 ins. apart.

At Hacienda Chiquitoy, the estate of Mr. LUIS JOSE DE ORBEGOSSA in the Chicama Valley, the seed is also inserted after irrigation of the furrows, but much more nearly flat. In still other *haciendas* the seed is laid flat in the row and covered either by hand or with small spades. In all cases it is the irrigation water which gradually fills in the furrows with the fine dirt. Seed selection on any systematic scale is, unfortunately, quite uncommon in Peru and not only bored, but frequently mixed seed is currently planted. This is one phase of the routine which could be very easily and quickly bettered.

The first weeding is commonly carried on by having the boys pull out the weeds in the rows by hand. Until irrigation water touches the middles, there is no weed growth and by the time this occurs the cane is pretty well closed, so that middle cultivation needs very little attention. Fertilizer, consisting almost entirely of the island guano, containing about 12½ per cent. nitrogen, 8 to 9 per cent. phosphoric acid and some 2 per cent. potash is usually applied at the rate of 1000 to 1500 lbs. per acre about three months after planting. It is almost universally thrown into the rows by hand after being ground either at the factory or right in the field and is covered by means of a 6-in. share plough drawn by oxen with very wide yokes—or, when labour is very cheap, it may be covered with spades. Quite frequently in the Chicama Valley, shortly after planting in the case of plant cane and just after off-barring in that of stubble, about 100 lbs. of nitrate of soda, or about 15 lbs. of nitrogen per acre, are applied in the irrigation water. Occasionally much heavier amounts of nitrate are employed, but this is altogether exceptional.

Irrigations are now given as frequently as the available supply of water will permit—and as heavily. Plant cane is usually harvested at from 20 to 22 months of age, the water being retired and the process of *agoste* begun by cleaning out all drainage ditches some three to four months before the field is scheduled for harvest. With the exception of the Tambo Valley and of the fields from which the comparatively small amount of seed cane is cut each year, since only about 10 per cent. of the average plantation cane area is renovated yearly, practically all fields are burnt over before harvesting. Almost without exception, too, the cane is transported by means of portable track, which is laid and removed in the various fields in a surprisingly quick and efficient manner. The temporary rails are laid at intervals of not over 50 metres across the furrows, so that the maximum carry for the loaders is never more than about 80 ft. The cane loaders are about the best paid field men and with hard work can earn about two and one-half *soles* (actual value of the *sol* is about 37 U.S. cents) and a ration of 1 lb. of meat and ½ lb. of rice in addition, per diem. Wages in general are paid by the task, or *tarea*, and will probably average about one *sol* and the value of the above ration. The loaders at several of the larger estates received 28 centavos per ton and seemed to be loading about six to eight tons per day in the case of the very best workmen.

The treatment of stubble cane is similar to that of plant. One of the unique operations in the rather unusual system of Peruvian cane culture is seen just after the cane is cut. It is called the *desbroza* and consists of absolutely cleaning the field of all tops and trash of any sort. This is generally brought out to the headlands by boys, using sacking for transporting the rubbish, and is burnt on the headlands as soon as dry. Some three weeks after the *desbroza*, or when the newly sprouted rows are well delineated, the cane is off-barred with a mouldboard plough without a coulter, nothing being done to the middles at this time, quite contrary to the practice in most countries. In about two months fertilization is carried on as for plant cane and in about the same proportions, the nitrate, if used, having been already applied to the rows immediately after off-barring. After the regular fertilization with guano the dirt is returned with a small mouldboard plough and the middles broken out with two additional furrows. Later operations are confined—and this only in some cases in the Chicama Valley—to subsoiling with the mouldboards removed from the ploughs. Stubble may be cut at from 16 to 20 months, usually closer to the latter figure, and is continued for from 6 to 11 outings, or from 10 to 18 years, depending on the yields and the quality of the land. Most of the *haciendas* count on renovating 10 per cent. of their cane lands annually and on grinding each year about 55 to 60 per cent. Irrigable land is very valuable on account of the high yields obtained, selling at from $175 to $400 per acre. Yields run anywhere from 40 to as high as 90 tons of cane per acre.

A discussion of agriculture in Peru would not be complete without some reference to some very good light tractor cultivation which the writer saw being carried on in several of the *haciendas*. At San Nicolás estate in the Supe Valley he saw excellent work being done in off-barring one row at a time and applying fertilizer with a distributor drawn by the same Fordson tractor. The off-barring was done by means of a mouldboard plough on each side of the row, attached to a rigid horizontal bar. This was followed by another drawing a large double mouldboard plough which broke out the middles, covered the fertilizer and returned the dirt to the cane very neatly indeed. At Hacienda Laredo, in the Santa Catalina Valley, Mr. JUAN C. QUEVEDO was doing very good work with Moline tractors, burning alcohol made on the place. Both for off-barring and returning the dirt he was working two furrows at a time with ease. In off-barring four small mouldboards are attached to a rigid horizontal beam in such a way that the row in the middle is off-barred at either side and one side of each adjacent row is also cleanly off-barred. For returning the dirt two wide double mouldboard ploughs are substituted for the four single ones and these are of just the proper width to break out the middles nicely and join the returned dirt in the middle of the row. Mr. VALENTIN QUESADA, manager at the Paramonga estate in the Patavilca Valley, was doing good work, also, with light tractors in off-barring and hilling-up with "Internationals." One attempt at tractor cultivation with the Fowler engines drawing four ordinary double mouldboard ploughs loosely hitched to a horizontal beam, with a man behind each plough, did not appear to the author to be particularly economical and, with the narrow middles employed in Peru, it would be very risky to attempt to hill-up in this way by the use of such apparatus as is employed for furrowing with these locomotives, as a slight misalignment might mean the ploughing out of several rows in a jiffy. Another disadvantage of the practice referred to was that the engines were drawing the ploughs only the length of one *cuartel*, or 400 to 500 ft., whereas to give economical results these engines should work at least 1500 to 1700 ft. apart.

INSECTS AND DISEASES.

The only pest worthy of the name is the ubiquitous stalk borer, *Diatraea saccharalis* Fab., which is widely distributed and at times enormously injurious in all the valleys except Tambo. It is a notable fact that the only valley in which no cane borer could be found is also the only one in which the cane is never burnt and there can be no possible doubt that the almost universal burning over of the fields must destroy large numbers of the natural enemies of the borers. The worst damage from the borer was noted in the *Zaña*, Lambayeque and Chicama Valleys, in the extreme northern section of the belt, and in a few cases large fields were seen which had been practically destroyed by borers in the cane lodged by the floods of 1925. Several parasites of the borer were observed, amongst them *Hemibracon sp.*, which was noticeably abundant around borer holes in piles of seed cane at the Puente Piedra estate in the Carabayllo Valley. The widely distributed egg parasite, *Trichogramma pretiosa* Riley, was almost ubiquitous in every valley and particularly abundant in Supe, while a muscoid parasite described by Dr. C. H. T. Townsend was also observed in the Chicama Valley in considerable numbers, parasitism up to 10 per cent. with this deipteron being found amongst larvae collected at the Chiclin estate. The multiplication of these natural enemies is one of the problems which the new Institute of Agricultural Paraitology, the first section of the projected experiment station, is now studying.

Despite very close attention to its possible occurrence in Peru, the author's visits to all of the cane valleys failed to reveal any sign of the dread mosaic disease which has caused so much havoc in other cane-growing countries, nor of gummosis, caused by *B. vascularum*, which is even more to be feared. As a matter of fact the writer has never seen anywhere such complete absence of disease in canefields as in those of Peru, even the common leaf spots, *Helminthosporium*, *Leptosphaeria*, etc., being conspicuous by their absence. Every attempt should be made to maintain this unique freedom from disease by strictly limiting importation of new varieties to the new projected agricultural experiment station and by allowing only a few varieties to be imported even by the Station, these to serve as parents for the breeding of Peruvian seedling canes. This point has also been extensively treated in the project for the foundation of the experiment station submitted by the writer to the National Agrarian Society, the representative agricultural organization which is seeking to establish this much-needed institution.

Correspondence.

"MILL - SHREDDERS"

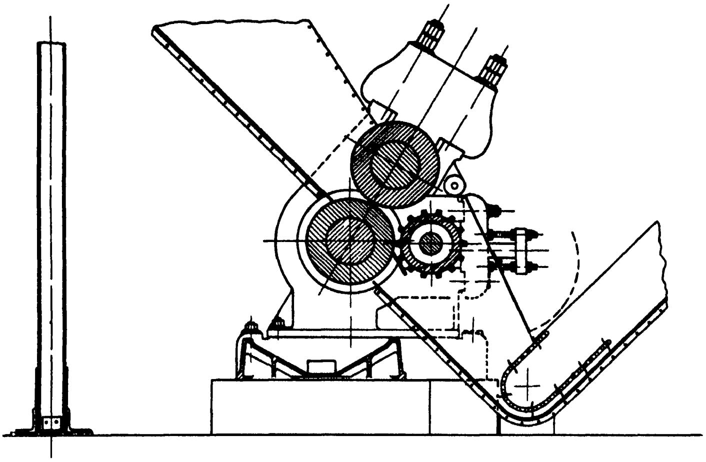
To the Editor, "The International Sugar Journal."

Sir,—In the October issue of the *International Sugar Journal*, on page 551, there appears, under the heading "The Farrel Mill-Shredder," a paragraph reading : "A variation of the design (referring to the Maxwell Crusher-Shredder), is, however, being installed at Central Espana, Cuba, by the Farrel Foundry & Machine Co. (manufacturers in the U.S.A. of the Maxwell Patents) to which they are giving the name of "Mill-Shredder."

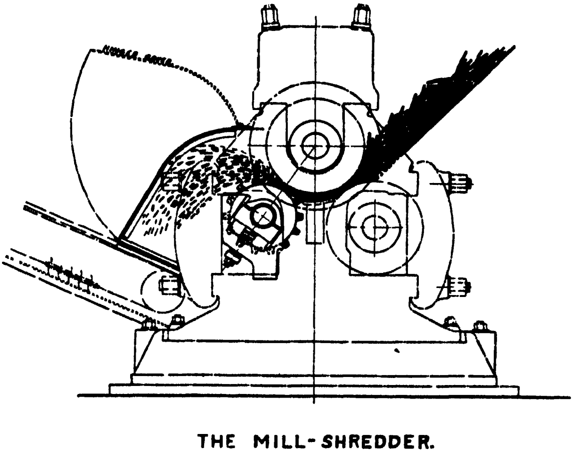
In view of some confusion already having arisen in regard to the nature, and application of my invention, I beg to call attention to one or two misstatements in the above quotation.

Both names, "Crusher-Shredder" and "Mill-Shredder," have been coined by the present writer with the object of distinguishing two methods of applying one and the same invention, which, to quote the U.S.A. Patent, is : "A machine constituting a combined crusher and shredder for sugar cane, comprising a stand or unit of crushing and shredding rollers, and driving means therefor." Briefly the "Crusher-Shredder" is a crusher provided with a Maxwell shredder roll, that co-acts with either of the crusher pair, while the "Mill-Shredder" is an existing common 3-roller mill (usually the first unit), with the sole alteration that a Maxwell shredder-roller takes the place of the bagasse or discharge roller. In order to make this distinction clear the drawings 1 and 2 are hereto appended.

In conclusion, I may add that the machines appearing under the names Farrel-Maxwell "Crusher-Shredder" or "Mill-Shredder," (erroneously called the "Farrel Mill-Shredder" in your issue), and the Maxwell "Crusher-Shredder," or "Mill-Shredder," are practically identical machines, with the only difference that the former are being made by the Farrel Foundry



THE CRUSHER-SHREDDER.
A CRUSHER PROVIDED WITH A MAXWELL PATENT SHREDDING ROLLER.



THE MILL-SHREDDER.
AN EXISTING MILL OF WHICH THE DISCHARGE ROLLER IS REPLACED BY A PATENT MAXWELL SHREDDING ROLLER.

& Machine Co., U.S.A. (who have acquired my patent rights for the Western Hemisphere), and the latter by the Sugar Machinery Mfg. Co. Ltd., London (who are manufacturing under license, while I retain the patent rights).

Yours faithfully,
Francis Maxwell.

Mauritius.

Department of Agriculture Report for 1925.

The annual Report of the Department of Agriculture of Mauritius for the year 1925, as prepared by Dr. Tempany, the Director of Agriculture, deals *inter alia* with the sugar industry of that island, but at somewhat less length than has been the case of late years. From it we cull the following.

The crop.—The preliminary compilation of factory results for the 1925 crop gave a total of 233,000 metric tons, which is but slightly below the normal output. Yields in the fields during October and November were considerably above anticipation, while the sucrose content of the cane was, throughout the grinding season, generally above normal. This output compared with 224,710 tons in 1924 and 201,550 tons in 1923; it was the highest since 1920 when 259,870 tons was cropped. Of this estimated yield, 98 per cent. should consist of *vesou* sugars, the rest being low products.

Owing to the relatively dry conditions which prevailed during the winter season, the sucrose content of the cane was high and the extraction of sugar per cent. of cane generally very satisfactory. The average figure for the whole island is estimated at 10·7 per cent., as compared with 10·28 and 10·51 in 1924 and 1923 respectively. One has to go back again to 1920 to find an equally high yield.

Factory conditions in 1925.—The altered economic conditions have rendered the necessity for centralization more imperative. Three factories have been dismantled in 1925, viz.: Bois Rouge, Rich Fund, and Riche Bois; and it is probable that at least two more will be closed before the next campaign. The total number of factories was thus reduced, at the end of 1925, to 45. New sugar machinery, to the value of Rs. 1,350,069, was imported during the year and tramway material to the value of Rs. 622,687.

Area under cultivation.—At the end of 1924, the area under cane cultivation approximated to 160,200 arpents (167,165 acres), the decrease on the 1924 figure being 3,900 arpents. It is probable that a further reduction of the same order will be in evidence in 1925, but no figures are as yet available. Sales of properties on the morcellement system have been little in evidence during the year, while several hundreds of acres, cultivated by small planters on the morcellement system, have been abandoned by their cultivators and have reverted to the estates with which the morcellement originated.

Indian cultivation.—At the end of 1924 the area cultivated in cane by Indian planters approximated to 60,500 arpents (63,000 acres) or 44·3 per cent. of the total cane cultivation. This area will probably evince a decrease in 1925 for, owing to the low quotations for sugar during the year, many of the smaller planters have found it more profitable to devote themselves to some other cultivation.

Disposal of the sugar crop.—The Sugar Planters' Syndicate continued operations during the year and controlled more than 80 per cent. of the sugar production of the Colony. The mean price realized for the 1925 campaign was Rs. 9·34 net per 50 kgs.; after all deductions, the planters received Rs. 8·95 per 50 kgs. In 1924, the mean sale price was Rs. 12·30 net per 50 kgs. and in 1923, Rs. 18·94. The past year was thus extremely unfavourable from the financial point of view and, with very few exceptions, sugar companies closed the year with a deficit.

Previous to 1914, the bulk of the sugar production of the Colony went to India. Between 1914 and 1924 the majority of it was exported to Great Britain. In 1924, however, a considerable resumption of exportation to

India occurred but stopped abruptly in 1925. Figures for the past four years are as follows :—

Crop of	Export to India. Tons.		Total Export. Tons
1922-23	267	....	205,382
1923-24	2,300	....	180,773
1924-25	168,217	....	219,281
1925-26 (to date)	22	....	195,681

Conditions affecting the sugar industry.—In view of the collapse of the sugar market, strenuous efforts have been made on estates to reduce the cost of production. Agricultural labour has now been brought down almost to pre-war rates ; many of the smaller planters have found it impossible to depend only on the cultivation of small holdings of ½ to 1 or 2 acres and hired themselves out again to large estates. As a result, an influx of labour became evident as soon as the trend of the sugar market was clearly downward. During the latter part of the year, agricultural operations could be performed as they had never been since 1914. Implemental cultivation in Mauritius has come to stay and, with the help of ploughs and tractors and the much cheapened cost of labour, there is every reason for believing that the cost of production will, henceforth, be considerably reduced. The economic crisis has brought almost a considerable amount of re-adjustment in the way of estate ownership, accompanied by a pronounced fall in the value of sugar lands. This movement will, it is anticipated, continue throughout the present year, thereby placing the whole industry on a more secure economic basis.

Instrumental cultivation.—Considerable progress, in this respect, is again in evidence. At the end of 1924 the number of tractors in use in the Colony amounted to 92. During the present year, ploughs and tractors to the value of Rs. 160,150 have been imported. There is no doubt that the extensive use of mechanical contrivances on estates has gone a long way towards bringing round the local labour to a saner view of the altered conditions of the sugar industry.

Irrigation of sugar cane.—Considerable progress was made with the La Nicoliere irrigation scheme during the year. The Government Experimental Station at Medine completed its last year's working in 1925, and under the approved arrangement reverts to Medine estate. The report on the results is now in course of compilation and will be completed during the year.

Pests and diseases of the sugar cane.—*Phytalus Smithi* continued to be the most serious pest of the sugar cane met with in Mauritius. During the season 1924-25, 62,251,000 beetles were destroyed at Pamplemousses. The area infected with the pest at Moka was found during the year to be very considerable and special arrangements had to be made for the conduct of the campaign at the point. In all 4,352,000 beetles were destroyed at Moka. In Savanne, while the original infection at Joli Bois kept within bounds it was found that the infection had spread to adjacent properties in spite of all precautions. The enlargement of the quarantine area therefore became necessary. The total number of beetles captured at the point was 1,816,000. Extensive experiments with calcium cyanide and paradichlor were conducted against the pest during the year but without favourable results.

In relation to other pests and diseases, owing to the risk of introduction of mosaic disease the addition of a plant inspector was made to the staff of the Botanical Division and regular visits of inspection paid to sugar properties throughout the island. This has enabled a much more accurate idea to be formed of the position in relation to cane diseases than was heretofore possible.

One of the results of this inauguration of the plant inspection service was the discovery of *streak disease*, hitherto unrecorded in Mauritius. Up to the present the disease has been found on sugar cane on four different sugar estates and at the Central Experiment Station, Réduit. Three of these estates are in the Rivière du Rempart district and one in the Black River district. Infected stools, where found, have been destroyed, warning given to planters as to the possible danger of planting infected "tops," and experiments carried out at Réduit to determine the effect on the crop of planting infected "tops" and the means of its transmission from infected to healthy shoots. A similar disease has been discovered on maize, coix edulis and eight species of wild grasses widely scattered all over the island. The aerial transmission of the disease from infected to healthy sugar cane is not readily effected in Mauritius.

Gumming disease caused by *Bacterium vascularum* was reported widely distributed over the island, chiefly on the White Tanna, but in a mild form where found. Smut caused by *Ustilago sacchari* was reported from ten estates in the drier parts of the island, six being in Rivière du Rempart, two in the Pamplemousses district and two in the Black River district; D.K. 74 was the variety most affected. Pineapple disease caused by *Thielaviopsis paradoxa* caused losses chiefly through the partial or complete destruction of cuttings. The Bordeaux mixture treatment was recommended.

Root disease was prevalent and is apparently due to a variety of causes. In most cases the disease appears to be aggravated by dry conditions, lack of drainage, cultivation, fertilizers, and other unfavourable conditions. *Thielaviopsis paradoxa* was isolated from the reddened tissues of diseased rhizomes, including the rhizomes of virgin M. 55 and White Tanna canes showing typical symptoms of root disease at Beau Vallon estate. In most of the cases of root disease examined at the laboratory, *Fusarium Sp.* was the organism most frequently encountered in association with drying roots.

Red rot caused by *Colletotrichum falcatum* was reported from seven estates widely separated on the White Tanna, D.K. 74, Iscambine, Senneville, Louzier and M.B.I. varieties. An acute form of *leaf spotting* due apparently chiefly to *Helminthosporium sacchari* was encountered on several estates during the year. The spotting due to *Leptosphaeria sacchari* was widespread but generally in a less acute form.

Mosaic disease has not again been recorded in the island, and it seems clear that the measures taken when the imported Indian canes were found to be affected, have very fortunately stamped out the malady. The disease exists in Réunion, and the chief danger is that of introduction from that island. So far as possible, plant quarantine precautions are rigidly enforced with a view to keeping the disease out of Mauritius.

Investigations in relation to the sugar industry.— Research and investigation have followed the usual lines, and it is anticipated that during 1926 the results of several important pieces of work will be sufficiently far advanced to permit of publication.

According to a Dept. of Overseas Trade report, the Formosa sugar season just ended has resulted in a total production of 8,115,231 piculs (479,204 tons) of centrifugals. Production of brown sugars amounted to 220,000 piculs, or 12,991 tons. The output of centrifugals in the 1924-25 season was 7,992,348 piculs (472,000 tons), the increase in the season just over thus being 122,883 piculs, or approximately 7,000 tons.

Electricity for Variable Speed Mill Drives.

By L. B. WHITAKER, A.M.I.E.E., Jamaica.

To one who has been watching the application of electricity to sugar factories for some time past, it is particularly noticeable that this all-important subject seems to have been dealt with in a somewhat loose and casual way, and compared with those other industries where the electrical drive has been successfully installed under even more adverse working conditions one is forced to think that the choice of electrical apparatus and systems of working has not been given the expert consideration it undoubtedly needs.

We are at present hearing a good deal about the necessity of Variable Speed Mill Drives, and in noting the remarks of various authors on this subject one is struck by the fact that it seems to be taken for granted that alternating current motors cannot be obtained to give variable speed without recourse to the wasteful method of inserting resistances in the rotor circuit where the power dissipated is proportional to the decrease in speed below synchronous speed.

Naturally such an important problem as this has had the attention of electrical engineers from the first, and as a result there have been alternating current motors on the market for some years which are capable of efficient speed variation.

A well-known type is the single field cascade motor in which the line frequency and slip frequency currents circulate in the same windings, and by taking different paths produce different numbers of poles giving a wide variation of speed at efficiencies and power factors comparable with those of ordinary induction motors. Such machines are largely used in collieries for winders where smooth speed variation is essential.

We now hear of proposals whereby the necessary speed variation for cane mills is to be obtained by the installation of D.C. motors. Although the speed control of these motors is easily and economically effected by varying the strength of the field, it seems a retrograde step to adopt D.C. working in opposition to the general tendency all over the world where alternating current is replacing the older system on grounds of simplicity and cheapness, and also because of the difficulty of building satisfactory D.C. turbo-generators to operate at the speeds called for in modern steam turbine practice.

A proposal whereby such D.C. mill motors should be supplied from D.C. turbo generators on the same shafts as the alternators driving the rest of the factory, seems likely to be expensive and unsatisfactory : firstly, because of the inherent weakness of the D.C. turbo generator with its expensive and unsatisfactory commutating gear, and, secondly, the further complication of the switchboard layout due to the two different forms of energy ; and thirdly, the lack of flexibility of the whole system, due to the fact that these two different transmissions cannot be linked together, which also results in the necessity of installing spare sets to cover both.

Statements have also appeared in the Press that the wiring costs of the D.C. system are less than the A.C. ; but this is entirely incorrect, and any electrical engineer knows that the weight of the copper in a 3-phase system is only three-quarters that of a D.C. 2-wire system of the same length and transmitting the same power at the same voltage, this being another of the reasons why alternating current is used in preference to direct current.

Even if we assume that it is impossible to avoid installing D.C. motors to drive the mills, a better method than using D.C. turbo generators would be the installation of a comparatively slow speed motor-generator which could be placed alongside the mills in order to shorten the D.C. wiring as much as possible, and by using one of the many methods of power factor correction in conjunction with the motor end of this unit, an improvement of the power factor of the whole factory system could be effected, which would more than wipe out the losses occasioned by the conversion of A.C. into D.C., and would enable the turbines to be run at full capacity, at the same time retaining perfect flexibility of the system with the installation of the minimum number of spare sets in the power house.

We offer these few remarks in the hope that this question of the complete electrical equipment of sugar factories will in future be given a thorough airing, so that the advantages and possibilities of the electric drive will be fully realized, and that we shall no longer see the anachronism of new factories being built which are driven by a number of small steam consuming units, but that the all-electric factory specially designed for the electric drive will soon be standard practice.

Spontaneous Combustion.[1]

By J. P. FOSTER.

With reference to the spontaneous combustion of bagasse, I have found much tradition, a great deal of superstition, no bibliography, and very little information. In the effort to gain direct information upon the subject, an intensive study was begun during the crop of 1925 and continued during the crop of 1926 and up to the present time. Very large numbers of samples of bagasse have been tested to determine the point at which ignition will occur, the determinations being made over a mercury bath, a sand bath, and by various other means. Determinations were made upon bagasse dust, fine bagasse, and bagasse of the ordinary composition which results from grinding through a 15-roller mill. During these investigations the point at which the first sign of discoloration took place was called the charring point, average figures operated being as follows :—

	Charring Point.	Ignition Point.
Bagasse dust	325° F.	475° F.
Fine bagasse	340° F.	500° F.
Ordinary bagasse	350° F.	550° F.

These figures are the minima of a very large number of determinations extending over two years, which have been determined at moisture contents from zero to 60 per cent., and sucrose from zero to 10 per cent. The higher sucrose figures being obtained by the addition of molasses to the bagasse in order to simulate as far as possible the conditions which might arise where molasses is trickled on to bagasse for fuel purposes. To our surprise, we found that the addition of molasses up to 8 per cent. sucrose in bagasse increased the ignition point. It is, therefore, very conservative to say that combustion of bagasse cannot occur at temperatures below 325° F. In order to determine as fully as possible the actual temperature changes occurring in bagasse while in storage, two bins, 10 ft. sq., containing 1,000 cub. ft. each, were filled with fresh bagasse, the bulb of a recording thermometer being placed about the middle of each bin. One bin was filled with bagasse from a 21-roller mill and contained 44 per cent. moisture and 2 per cent. polarization, while the second bin was filled with bagasse from a 12-roller mill and contained 48·2 per cent. moisture and 4·73 polarization.

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[1] Report (here abridged) presented to the Association of Hawaiian Sugar Technologists, October, 1926.

Temperatures of both for a period of 25 days were made into a graph. Therein it was noticed that the higher moisture with its higher sucrose accompaniment showed the most rapid rise in temperature. In 24 hours the temperature increased to approximately 110° F., and in 3 days more the temperature went to 120°, thereafter remaining constant for three days, when there followed a gradual rise in temperature up to 141° maximum. After that time the temperature remained constant for five to seven days more, and then very gradually began dropping. The total rise in temperature from the initial temperature of the bagasse leaving the mill was less than 60°, and a rise of at least 240°, or four times the observed increase would be required before any apprehension should arise.

Systematic sampling and analysis of the bagasse were made daily from each bin over a period of about two weeks. Bagasse from the 12-roller mill polarized 1·89 the second day; 0·2 the third day; and thereafter gave a negative polarization. But the bagasse from the 21-roller mill gave zero reading the second day and thereafter a negative reading. Considering the rapid disappearance of the sucrose to be indicative of fermentations in the bagasse, analyses for alcohol were made and qualitative reactions were obtained for both ethyl and methyl alcohols, the latter test being made by the chromate and potassium permanganate test. It is evident that fermentation had ceased within a very short time, and that it had little if any effect upon the increase of temperature.

In order to study the possibility of other reactions occurring, two laboratory silos were constructed, and filled with bagasse, sealed, and connected with a gas collecting apparatus. For the first three days a considerable amount of carbon dioxide was given off, reaching the peak on the second day, and by the ninth day the evolution of gas had ceased, during which time there was no increase in temperature observable. At the expiration of 15 days one silo was unsealed, and its contents exposed to the air; into the second silo a steady stream of oxygen was introduced, the temperatures of each silo being recorded from day to day. Both silos had a noticeable increase in temperature, but the one exposed to the air had a greater gain than that into which oxygen had been introduced. In 11 days the temperature in the open-air silo increased 13° and that into which oxygen was introduced increased 5°, the maximum temperature reached being 93° F.

The conclusion was reached that the observed temperature rise, both in the large bins and in the laboratory silos, was due to oxidation, slightly influenced by fermentation. There is no doubt that complex and practically unknown reactions occur in bagasse while in storage; but no reactions observed, either of natural occurrence or artificially induced, produced temperature rises even remotely suggestive of danger. In an article read before the Association at its last annual meeting, the statement was made that " a boiler or heating device so installed that it heats surrounding wood or other inflammable materials to a temperature of 150° F. or slightly more, and for a considerable period of time, is likely to cause a fire." This suggested an experiment in which two 110-volt, 40-watt electric light globes were each equipped with a simple form of rheostat in order to control the flow of current into the filament of the lamps, while two lamps were buried in bagasse and a check upon the temperature readings maintained over a considerable period. One sample ranged from a minimum of 140° F. to a maximum of 191° F., and the second from a minimum of 190° F. to a maximum of 350° F. But up to the time of writing (August 5th) no sign of charring or other indication of combustion has been visible. This experiment is interesting, but of course far from conclusive, in that it is purely negative.

Hawaiian Factory Results, 1925 Season.[1]

The outstanding feature of the 1925 campaign[2] was the increased grinding rate of practically all the mills in the islands. The average rate was 45·31 t.c.h. in 1925 against 36·58 t.c.h. in 1921 when the grinding was the slowest, or an increase during that period of 24 per cent. The 1926 campaign will probably result in a still higher average speed of grinding if the present rates are maintained.

While the speed of the factories has been increased, there has been but a very slight lowering of extraction and the amount of extra fuel that it was necessary to burn decreased 8 to 9 per cent. of that required in 1924.

The tendency is to maintain fairly heavy hydraulic pressures on the mills and to decrease the amount of maceration water. The largest average maceration was 40·80 per cent. in 1919, and since then the amounts have consistently decreased until the average was only 33·63 per cent. for 1925.

Increased attention to sanitation around the mills has probably resulted in reducing the unknown losses due to inversion that occur there, the decrease in purity between first expressed juice and mixed juice being a rough index of this.

Factories which had the highest extraction for the year were Hakalau 98·93, Waimanalo 98·73, Onomea 98·73, Hilo 98·39 and Olawalu 98·17.

Chemical control in the factories is improving each year. A new process of determining sucrose in final molasses (Walker's dry lead method)[3] was used as it had been found that results by the old method were somewhat too high. Twenty-seven factories are now reporting on a sucrose instead of a polarization basis, this being an increase of two since 1924. Thirty-six factories weigh the juice entering the boiling house and only four of the smaller ones measure it. Twenty-five weigh the final molasses and ten measure it.

Most factories are liming the mixed juice to alkaline or nearly alkaline to phenolphthalein, which the H.S.P.A. Experiment Station has shown to be the optimum point. Control of the *pH* reaction of the clarified juice is made possible by the use of colour charts and the proper reagents. Kopke turbidimeters are also being widely used to measure the clearness of the clarified juice.

The least satisfactory department in the Hawaiian factories is the filter-press station. The polarization in the mud was 2·28 per cent. in 1925 and the feeling is that other losses in this station make up a considerable part of the undetermined loss.

Average gravity purity of the final molasses was 37·32 per cent. which is a new record. While the equipment at the centrifugal station has not been increased much in recent years, there has been a better utilization of available capacity. It will be noted that the average density of final molasses has been increasing steadily, indicating that the low grade massecuite was dried heavier to get a lower purity final molasses. Kahuku established a new record for final molasses with a purity of 32·46 and Pepeekeo came second with 32·96.

The tendency in the handling of commercial sugar strikes is toward a modified straight boiling method. Such a system of boiling was satisfactorily used at the factories of Hawaiian Agricultural Company and Waialua last year. In this system the ideal is to boil two " A " (high purity syrup) strikes and take back all the molasses from these strikes into a " B " (low purity

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[1] Abridged from the Annual Synopsis of Mill Data of the Hawaiian Sugar Planters Association.

[2] *I.S.J.*, 1925, 486, for 1924 figures.

[3] *I.S.J.*, 1918, 239 ; 1921, 613.

72·75 per cent.) strike and thus eliminate all the molasses from the commercial sugar strikes in two boilings. The Pioneer System is still used in most of the factories and some still cling to the old method of boiling all strikes to constant purity.

Polarization of commercial sugar was 97·22 which is a slight increase over the previous year, due to contracts with refineries which make it profitable to manufacture a sugar of high polarization.

Factories listed in order of the overall recovery of polarization in the cane are: (1) Hakalau 92·07 per cent., (2) Onomea 91·69 per cent., (3) Pepeekeo 91·63 per cent., (4) Hawaiian Sugar Co. 91·03 per cent., (5) Wailuku 90·72 per cent., (6) Honomu 90·67 per cent., (7) Ewa 90·01 per cent., (8) Oahu 89·73 per cent., (9) Paauhau 89·72 per cent. and (10) Pioneer 89·68 per cent. Factories which reported over 101 per cent. recovery on available in the boiling house were left out of the tabulation.

	1916	1923	1924	1925
Total crop, short tons raw sugar	593,483	545,606	701,433	776,072
Factories in operation	—	—	40	—
Listed capacity t. c. h. average	—	—	46.80	46.80
Average grinding rate t. c. h.	—	42.03	43.63	45.31
Overall Recovery—				
Pol'n sugar, cane per 100 pol'n	87.98	88.77	88.94	89.11
Extraction	96.87	97.23	97.33	97.29
Boiling house recovery	90.84	91.28*	91.391	91.59*
Losses per 100 *pol'n in Cane—*				
Bagasse	3.13	2.77	2.67	2.71
Press-cake	0.30	0.40	0.31	0.38
Molasses	7.41	7.58	7.41	7.07
Undetermined	1.18	0.48*	0.61*	0.731
Cane—				
Polarization	13.45	12.78	13.26	13.22
Fibre	12.74	12.82	12.74	12.74
Tons cane per ton sugar	8.16	8.56	8.26	8.27
Bagasse—				
Polarization in bagasse	1.81	1.55	1.56	1.58
Moisture in bagasse	42.49	41.56	41.58	41.56
Maceration water per cent. cane	39.85	35.12	34.90	33.63
First Expressed Juice—				
Brix	18.64	18.09	18.51	18.42
Purity	87.70	87.05	87.86	87.92
Mixed Juice—				
Brix	13.17	13.13	13.52	13 60
Purity	84.59	84.27*	85.05*	85.20*
Last Mill Juice—				
Brix	1 75	1.70	1.96	1.94
Purity	71.71	68.31	71.62	69.71
Syrup—				
Brix	62.73	63.26	63.32	63.65
Purity	86.18	85.65	86.32	86.27
Press-Cake—				
Weight per cent. cane	2.20	2.22	2.16	2.23
Polarization	1.82	2.31	2.26	2.28
Molasses—				
Weight per cent. cane	2.90	2.89	2.90	2.79
Gravity solids	87.63	88.53	88.81	89.75
Gravity purity	39.25	37.90	38.16	37.22
Commercial Sugar—				
Polarization	96.31	96.90	97.18	97.32
Moisture	1.06	0.83	0.74	0.79

* Figures influenced by Petree Process installed in two of the largest factories, their basis for chemical control being the analysis and weight of the clarified juice.

Philadelphia Meeting of the Sugar Section of the American Chemical Society.

The 71st Meeting of the American Chemical Society took place this year at Philadelphia, Pa., September 6th to 11th, and the following are abstracts of the papers read before the Sugar Section :—

Studies in the re-activity of the methylated sugars : the Lobry de Bruyn inter-conversion.—**W. Lee Lewis, M. L. Wolfrom and R. D. Greene.** Application of the Lobry de Bruyn inter-conversion reaction to tetramethyl glucose and tetramethyl mannose, wherein one of the mobile hydrogen atoms is replaced by a methyl group, has thrown some light on the mechanism of this change in the simple sugars and on the theories used by NEF and his students in explaining the re-activity of these sugars in alkaline media. Preliminary work to establish improved inter-conversion conditions was done with glucose and mannose. Under similar conditions "normal" tetramethyl mannose is converted into "normal" tetramethyl glucose. Both sugars must then possess the same oxidic linkage.

Deerr's double polarization method.—**C. E. Coates and Shennan Shen.** The method proposed by DEERR some years ago for double polarization using H_2SO_4 and aluminium sulphate for inversion, and precipitating with $Ba(OH)_2$ has been modified.[1] The Clerget figure for pure sugar was 141·7 which is practically that of the older figure for the invertase method. Directions are given which will make the method applicable generally.

Clerget constants by inversion with invertase.—**J. F. Brewster and T. Y. Chou.** Purified sucrose polarizing 99·9° on the Schönrock scale under the usual standard conditions served as a basis for the experimental work. Solutions containing fractions of the sugar normal weight varying from 0·1 normal to normal, and one solution 0·05 normal, were inverted with invertase and the invert polarizations read at varying temperatures. From the tabulated readings the Clerget divisor was computed for each temperature and concentration by the equation :—

$$D = \frac{(D - I)\ 100}{k - \frac{t}{2}}$$

where D = direct polarization of sucrose, I = invert polarization, t = temperature, and k = the constant to be determined. From the computed data curves were plotted on negative readings against temperatures for each concentration, whereby irregularities in temperatures of observation were smoothed out and new tables constructed, giving the Clerget divisor for each negative degree S, from —1 to —34° and for each two degrees of temperature from 18 to 34° C., this being after the manner of HERZFELD and of STEUERWALD. At 20° C. the polarization of the inverted half-normal sucrose solution was —16·04° S. The direct polarization of the half-normal solution of the sucrose as given above was 49·95° S. The negative divisor computed is $142{\cdot}11 - \frac{t}{2}$ the negative component being therefore — 32·11, agreeing closely with the recent work of others. The specific rotation of invert sugar from the half-normal weight of sucrose was calculated to b —20·298 at 20° C., no correction for weight in vacuum being made.

Rapid determination of gums in sugar products.—**Angel Acosta and James R. Withrow.** Earlier work by RUFF and WITHROW has been extended with the idea of reducing the time. For this purpose, centrifugal force in a modified Babcock tester was utilized. The gums were measured in capillary tubes after correlating weight with volume. Results were found to be sufficiently accurate to give encouragement.

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[1] *I.S.J.*, 1915, 179.

Effect of centrifugal clarification of maple syrup on its analytical values.—**J. F. Snell.** (1) Determinations of ash values and Canadian lead number in two syrups before and after centrifugal clarification revealed no measurable difference due to the clarification. (2) Examination of the sediments collected in the clarifier showed that the amount of ash material removed was too small to produce a difference in ash content of the syrup exceeding the limits of experimental error. (3) These sediments were similar in composition to maple sugar sand. That collected in the outer bowl consisted of finer particles and had a higher silica content than that in the inner bowl. (4) Froth skimmed from the clarified syrup separated sucrose crystals on standing. (5) When the froth as a whole was reconverted into syrup, the product gave ash and Canadian lead values practically identical with those of the syrup upon which the froth formed.

Decrease in reducing sugars during char filtration.—**George P. Meade and René Baus.** It has been maintained that during char filtration reducing sugars are selectively adsorbed by fresh boneblack and subsequently given up to the liquors in the later stages of filtration. Laboratory experiments fail to show any such selective adsorption and indicate that the decrease is due to a destruction of reducing sugars by the alkalinity of the boneblack. Analyses of liquors on and off refinery char filters support these laboratory findings. The importance of the point in its relation to the "glucose balance" of the refinery is discussed.

Levulose from the dahlia.—**William C. Arsem.** A process capable of commercial development has been devised for the extraction of pure inulin from dahlia bulbs. and the complete conversion of inulin to *d*-fructose, or levulose. Some new properties of inulin have been established and the mechanism of its hydrolysis has been studied. A non-crystallizing 80 per cent. syrup can be prepared, in which form it is particularly suitable for canning and preserving and for the manufacture of soft drinks, soda fountain syrups and table syrups. Some of the very numerous varieties of the dahlia have a high inulin content, and produce heavy clumps of bulbs; and, as the dahlia responds readily to breeding for special characters, it is expected that high yields per acre can be obtained. It is believed that levulose can eventually be produced at a lower cost than cane or beet sugar, and that it should replace these sugars for many purposes.

Some sources of error in the colorimetric determination of pH values.—**J. W. Schlegel and A. Stueber.** Various sources of error are pointed out, these being caused by faulty manipulative details and mainly to the preparation of the indicator dye. It was found that dye solutions standardized against standard buffer solutions give erroneous results when used with slightly buffered solutions, and a method is given for the preparation of a dye which will give correct results with both buffered and unbuffered solutions as met with in sugar refinery practice.

A study of cane juice defecation at various pH values.—**H. S. Paine and J. C. Keane.** In order to determine the optimum *pH* for defecating cane juice in raw sugar manufacture, different types of juice were limed to several different *pH* values and in each case the following determinations were made: Rate of settling of mud, volume and weight of mud, percentage of organic material in mud, colloid content of clarified juice (by the dye test), surface tension, colour, turbidity, and percentages of P_2O_5 and CaO. Some of these determinations were made on the original juice as well as on the clarified juice. In a factory producing raw sugar by ordinary lime defecation and granulated sugar by the double carbonation process, the dye test showed 14 per cent. colloid elimination by simple defecation and 69 per cent. elimination by the double carbonation process. Colloid elimination by ordinary defecation was lower than usual in this and other cases owing to the very low P_2O_5 content of the juice. In the case of juice of low P_2O_5 content, it was especially necessary to carefully control defecation at a lower range of *pH* values in order to restrict production of lime salts and a dark colour in the juice. The optimum *pH* for defecating cane juice in raw sugar manufacture may vary considerably with the type of juice, and is primarily dependent upon the P_2O_5 content of the juice. The drop in *pH* value from cold limed juice to clarified juice, in the case of juice limed to a *pH* of 7·5, varied from 0·46 *pH* to 1·78 *pH*. This drop in *pH* seems to be especially characteristic of juice from cane that has been cut some length of time.

Change in composition of liquors held in bonechar filters.—**M. S. Badollet and H. S. Paine.** Liquors held in bonechar filters for several days change in composition. Data have been presented to show that the condition of the bonechar (degree of exhaustion) is a predominant factor in the formation of invert sugar during a shut-down, or when liquors are held on char for a considerable time. Practically no inversion occurred in the case of liquors held in contact with bonechar which had been treated with caustic soda, the *pH* of the liquor entering the char filters being nearly the same as that of the liquor held in contact with partially exhausted char.

Relations between certain measurements and the refining quality of raw cane sugar.—**M. S. Badollet and H. S. Paine.** A study of the refining quality of raw sugars has been made, using such methods of measurement as ultrafiltration, dye test,[1] and filterability. Although no constant ratio exists between the values obtained by these methods, the data show that the results are comparable in that an increase in the colloid content of raw sugars causes an increase in the dye test value, an increase in the weight of colloids obtained by ultra-filtration, and a decrease in filtrability. Dye test values were obtained for over 70 different lots of raw sugar from as many different factories. These values showed about 100 per cent. variation from the highest to the lowest and varied in practically the same order as the refining character of the raw sugars as actually observed in the refinery where the sugars were refined. The dye test is a valuable index of the colloid content and refining quality of raw sugar and can be made rapidly.

Colloid elimination during bonechar filtration.—**H. S. Paine and M. S. Badollet.** A colloid investigation of the filtrates collected at intervals during a bonechar filtration of raw sugar melts in a refinery showed that the water-irreversible colloid (which is only partially removed by defecation in the raw sugar factory) is immediately and completely removed by the bonechar. No irreversible colloids appeared in the char filtrates even at the end of the filtration period when the char had become exhausted. On the other hand, the water-reversible colloids are never completely removed, even at the beginning of filtration with fresh bonechar, and evidence exists that this type of colloids is partially liberated from adsorption, due probably to change in the adsorption equilibrium, when the char filters are washed. This liberated colloidal material is returned to circulation in the refinery. Bonechar appears to show a distinct preferential adsorption for the water-irreversible type of sugar liquor colloids. This has an important bearing on the defecation requirements in raw sugar factories.

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[1] BADOLLET and PAINE, *I.S.J.*, 1926, 28, 23, 97, 137.

Testing, use, and revivification of decolorizing carbons.—**M. T. Sanders.** This paper contains a discussion of the properties of decolorizing carbons and of methods of evaluating them. Their action on aqueous solutions, on vegetable oils, and on hydrocarbons is described. A list of patents pertaining to the revivification of carbons together with a brief abstract of each patent is given.

Some interesting sugar-house scales.—**J. W. Schlegel and J. P. Manley.** The composition of a number of scales, as met with in refinery practice, is given, together with an explanation of their method of formation, etc.

Composition of raw sugar ash.—**J. W. Schlegel and A. Weber.** Complete analyses of the ash of a series of centrifugal, muscovado and molasses sugars are given, but no interpretation of the results is attempted. An average analysis, based upon production, is given, this average representing approximately the composition of the ash of 62 per cent. of the world's production of cane sugar. From the analyses have been calculated the factors to be applied for the conversion of sulphate to carbonate ash.

Ash in raw cane sugars, and the specific conductivity of their solutions.—**F. W. Zerban and L. Sattler.** Chemical ash determinations, and measurements of specific conductance have been made on 221 raw sugars from Cuba, Porto Rico, Hawaii, Philippines, Santo Domingo, and British West Indies. The ash was determined in the water-soluble portion of the sugars by the usual sulphate method, 10 per cent. being deducted from the result. The conductance was measured on solutions containing 5 grms. of sugar in 100 c.c. solution, using a cell similar to Lange's. It was found that there are considerable variations in the ratio of ash to specific conductance, not only for individual plantations, but also in the averages for different countries or provinces of a country. Nevertheless, in 84 per cent. of all the samples investigated the difference between the ash found and that calculated from the average ratio for each geographical division is within 0·02 per cent. on sugar, and in 93 per cent. of all samples within 0·03 per cent. However, there are some in which the discrepancy amounts to 0·04 to 0·10 per cent. Conductometric titrations have shown that these discrepancies are due to differences in the composition of the salts contained in the sugars, particularly to differences in the proportion between inorganic and organic anions. This problem is being further studied for the purpose of devising a simple method of ash determination based on electrical conductivity; temperature corrections, and the deduction to be applied to correct for the conductance of the water used have likewise been determined.

The electrolytic conductivity of solutions of granulated beet sugar.—**A. R. Nees.** Methods and apparatus for the determination of the specific conductance of solutions of granulated sugars are described. Relations between the specific conductance and ash in granulated beet sugars are given, together with a method of calculating the purity of the sugar. The specific conductance, expressed as a multiple of -10^{-5} divided by the factor 231·5 gives the ash in per cent. on sugar.

Grading of soft sugars.—**L. A. Mills.** Soft refined sugars are sold on the basis of colour and since they darken with age, some means for preserving grade colours unchanged is necessary. Colour standards made from ground glass of different colours moistened with glycerin were used for several years. This expedient has been supplanted by reading colours of sugars directly by reflected light in a Keuffel and Esser colour analyser at 5·60 wave length. The new Hess-Ives tint photometer with "5·60" glass screen has lately been tried out for the same purpose. Readings differ slightly from those made in the Keuffel and Esser instrument at 5·60 wave length.

Publications Received.

Die neue Dampfturbine "Bauart Brünn" in der Zuckerindustrie (The New Steam Turbine, Brünn System, in the Sugar Industry). Ing. Heinrich Jenisch. With figures, illustrations and graphs. Tagesfragen aus der Zuckerindustrie; No. 3. (Albert Rathke, Magdeburg, Germany.) 1926. 3 RM.

Preliminarlly the writer of this booklet of 48 pages sketches the history of the application of the steam turbine in the sugar industry, this having been initiated in Germany by an article in the year 1896 published in the *Vereins-Zeitschrift* on the recently introduced Laval machine, by Prof. SCHRÖTER. He next deals with the three systems, the action or impulse, the reactions and the Curtis turbines, and following this particularly with the advantages and construction of the Brünn turbine. Descriptions are given in detail of the installations in the Rohrbach, Grusbach, Pressburg and Wischau factories, the booklet concluding with a table giving operating data respecting the sugar plants in which the Brünn system finds a place, these amounting to 18 in all, three of which are in Java, and the rest mostly in Czecho-Slovakia.

Einführung in die Chemie der polymeren Kohlenhydrate (Introduction to the Chemistry of the Polymeric Carbohydrates). P. Karrer. (Akademische Verlagsgesellschaft, Leipzig.) 1926. Price: 16 RM.

This is a monograph on the chemistry of the starches, of glycogen, cellulose and other carbohydrates, one of a series of books on "Colloid Investigations," edited by Prof. ZSIGMONDY. It is a work that should be well appreciated by students of the polysaccharides as a guide to that field, which has now grown vast in its dimensions. The work is clearly written, and is valuable by reason of the many references it gives to the original literature. It is especially useful for the authoritative manner in which it deals with conflicting view points on recent developments.

Potentiometric Titrations. Dr. I. M. Kolthoff and N. Howell Furman. (Chapman and Hall, Ltd., London.) 1926. Price: 22s. 6d. net.

Potentiometric titrations are electrometric titrations in which the end-point is detected by measuring the change in potential of a suitable electrode, and is differentiated from conductometric titrations in which the change of electrical conductance is observed during the operation. It is a development which is being followed with interest by chemists generally, and may prove in time to be of practical importance in the sugar industry in connexion with the determination of hydrogen-ions. It has many applications in analytical practice, in the titration of Fehling's solution and glucose solution, for example, when the voltage is read between platinum and calomel electrodes, a sharp break setting in the titration curve just before the end-point.[1]

Standards of the Hydraulic Society, 1925. Third Edition. (The Hydraulic Society, 90, West St., New York.)

The Hydraulic Society encourages suitable standards of manufacture and of engineering practice in the pump industry, and the recommendations contained in this booklet are published as being the standard trade definitions and customs in the pump industry (in the U.S.A.). They include: principles of business conduct approved by the Society; standard classification of pumps; nomenclature; viscometer conversion chart; standard equipment and other data for various types of pumps; materials for special service pumps; various tables; and list of pump companies comprising the Society.

"Adco" Synthetic Farmyard Manure. KYNOCH Farmers' Bulletin No. 18. (African Explosives and Industries, Ltd., Umbogintwini, Natal). 1926.

The African Explosives and Industries, Ltd., are the sole South African agents of the "Adco" process of preparing synthetic farmyard manure from bagasse,

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[1] W. L. DAGGETT and others. *J. Amer. Chem. Soc.*, 1923, 45, 1043.

straw, veldt grasses, and other such materials containing organic matter. This leaflet is written on the same lines as the English booklet recently noticed,[1] but gives some additional data pertinent to local conditions.

British Sugar (Subsidy) Act, 1925. Section I: Factories. Ministry of Agriculture and Fisheries and Board of Agriculture for Scotland. (White Paper No. 133.) (H.M. Stationery Office.) 1926. Price; 3d.

This comprises statements (already summarized in our columns[2]) in the form of balance sheets transmitted by companies manufacturing sugar or molasses from home-grown beet in 1925-26.

Trade Notices.

Messrs. G. & J. WEIR, LTD., Glasgow, send us particulars of some Weir specialities. *Monel metal*: Every chemist knows the advantages of using monel metal. It is an alloy of nickel and copper with a small proportion of other metals; in appearance it is similar to nickel, but it has a tensile strength of about 42 tons per sq. in.; and exhibits remarkable powers of resisting corrosion, and the effect of acid and alkaline conditions. It is now made into castings and machined parts of every description for use in chemical works, but in the sugar factory, its principal use is in the form of woven wire cloth of fine mesh for straining raw juice, in which application it is easily superior to any other metal in several respects. *Turbo-feed pump*: Advantages of the turbine drive have led engineers to apply it to various forms of auxiliary machinery, especially perhaps in the special province of boiler feeding, for which purpose the Weir pump has proved eminently successful. It is automatic in action, noiseless and free from vibration, and combines maximum efficiency with minimum weight and space occupied. It is capable of discharging against the highest boiler pressures, and, subject to temperature conditions, is capable of lifting the water from the maximum possible depth. *Corrosion detector*: It is of importance especially for engineers in charge of power plants to easily examine the feed water at any point in the system in respect of corrosive properties. In the Weir apparatus designed for this purpose, the water under examination is passed over one side of a polished steel disc or plate, the other side of which is heated by a current of steam, any corrosive gases in solution immediately attacking the polished surface under these conditions. Literature on these three specialities will be supplied by Messrs. G. & J. WEIR, LTD., to those interested.

Messrs. POTT, CASSELS & WILLIAMSON, of Motherwell, Scotland, have just issued a new Catalogue (No. 82) of their well-known "Weston" Centrifugals and Accessories, consisting of some 158 pages of description and illustration. This firm have also available a very elaborate Spares List to help their customers in ordering spare parts; and they are prepared to supply additional and repair parts for all types of "Weston" Centrifugal Machines which have been in use in sugar producing countries and elsewhere since the introduction of the "Weston" machine. It may be added that Catalogue No. 82 can also be had at option in the French and Spanish languages.

Messrs. GEORGE FLETCHER & Co., LTD., have just published a booklet relating to special Fletcher Rollers for Sugar Cane Mills. These, on account of possessing a particular grain of metal, while being very hard, possess a roughness that extends right to the core of the casting. They are, therefore, claimed to have a long life and yet will not polish or lose their coarse open grain which is so essential for gripping canes. Messrs. Fletcher & Co., Ltd., cast their own rollers and so have complete control of the composition of the metal. A feature of this Catalogue is the provision on tracing paper of two outline drawings of rollers, to enable dimensions to be filled in and sent with enquiries or orders.

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[1] *I.S.J.* 1926, 436. [2] *I.S.J.*, 1926, 341.

Brevities.

According to the Jamaica Chamber of Commerce, the acreage devoted to sugar cane in that island during 1925 amounted to 50,488 acres, an increase of 5077 acres over 1924, while the 1926 acreage is expected to be 52,500. The coming crop is expected to reach 57,000 tons of sugar, of which 50,000 tons will be refinery crystals, and a like tonnage will be available for export. A considerable proportion of the sugar consumed in Jamaica is refined imported from Canada and the United States.

Mr. L. BLACKLOCK, Chemist of Hulett's Refinery, has found the following average figures for the bagasse of Natal sugar factories[1] : Water, 51·75 per cent. ; nett heat value per lb., 3452 B.T.U. ; and gross calorific value of the dry material, 8344 B.T.U., the latter (dry) values for Louisiana and Hawaii being 8360 and 8100 respectively.

Among new companies recently registered are : Hygienic Sugars, Ltd., 111, St. George's Square, Westminster, London, S.W. 1. Private. Sugar refiners and manufacturers, etc. Nominal capital, £5000 in £1 shares. This company is reported to be erecting a beet factory at a site between Shrewsbury and Wellington at a cost of £260,000, provided 8000 acres of roots are guaranteed.

Belgium is expected this year to produce 270,000 metric tons of beet sugar as compared with 350,000 tons last year, and 400,000 tons in 1924. A lesser acreage has been sown this year and the sugar content is not expect to exceed an average of 16 per cent. On the other hand consumption in Belgium continues to increase. The pre-war *per caput* figure was 26·4 lbs., whereas in 1926 it is expected to be nearly 60 lbs. As a result, only about 60,000 to 70,000 tons will be available for export.

According to a Reuter message from Brazil last month, the sugar combine in that country is proposing to dump in Europe if it can about a million bags of sugar or say one-fourth of the crop, in order to get rid of an unsaleable home surplus and thereby to raise home prices to a more remunerative level. Thus Brazil intends to follow in the footsteps of Cuba in endeavouring to dispose willy nilly of an excessive crop.

According to the Public Health (Preservatives, etc , in Food Regulations[2]) which will come into operation on January the 1st, 1927, the amount of sulphur dioxide (SO_2) in sugars sold in the United Kingdom must not exceed 70 parts per million (0·007 per cent.). This calls for attention on the part of manufacturers of sugars destined for importation into this country, though given efficient chemical service little difficulty in controlling this amount need be anticipated.

Referring to the paragraph which appeared on page 528 of our October issue regarding a rival to "Celotex," we omitted to state that the remarks quoted were reproduced from an Australian contemporary.[3] These remarks were to the effect that "an inspection of T-board leaves no one in doubt as to its superiority to 'Celotex' " Needless to add, this was not meant to be an expression of our own opinion regarding "Celotex," which we regard as a boarding material of exceptional qualities.

Some recent experiences with unsatisfactory concrete work showed failure to be due to traces of sugar in the cement employed, accountable probably to the use of bags in which sugar had been packed. In one case the concrete set very slowly, and produced a mass which was very soft and contained dangerous cracks. In other instances, in which the sugar contamination was less, the cement failed entirely to harden properly. This only confirms previous observations,[4] and anyway it is known that the presence of sugar (among other substances) reduces the resistance to the Le Chatelier test, lowering the strength of the mortar in proportion to the amount of sugar present. Even 0.1 per cent. only suffices to disturb the hardening process.

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[1] Proceedings of the Fourth Annual Congress, Durban, April, 1926.

[2] White Paper No. 775 of 1925; price 3d. ; H.M. Stationery Office, Kingsway, London, W.C. 2.

[3] *Australian Sugar Journal*, July 8th, 1926.

[4] *I.S J.*, 1923, 327.

Review of Current Technical Literature.[1]

OFFICIAL TESTING OF GRÄNTZDÖRFFER'S ELECTRICAL BOILING PROCESS. **Alex. Herzfeld.** *Zeitschrift des Vereins der deutschen Zuckerindustrie,* 1926, No. 834, 135-153.

GRÄNTZDÖRFFER, a well known German sugar engineer, has been working on a method of boiling in the vacuum pan by electrical heating, and now has elaborated his patented apparatus and process to such an extent as to warrant an official examination as to its merits at the hands of Prof. Dr. HERZFELD, Director of the Institut für Zuckerindustrie, Berlin. This was done at the Klützow factory, a modern beet-house, producing a fine grade of white granulated. Grantzdörffer's process[2] consists in passing an alternating current through the mass during boiling, grain being built up on " seed " consisting of powdered sugar which is drawn into the pan and distributed through the cuite by special devices, while the strike is maintained in a fluid state by drawing in continuously. As for the electrical equipment, this consists of a suitable number of electrodes built into the pant, here being at Klützow three in the lower conical part of the pan, these being surmounted by another three. Each electrode is separated from the other by a distance only of a few mm., since otherwise the resistance would be too great. In the immediate neighbourhood of the points of the electrodes there is an open steam pipe, it being claimed that by means of a current of steam " the electricity is better conducted." A current of about 10 amps. and 380 volts is employed. Numerous important advantages are claimed by the inventor for his electrical process, such as the shortening of the usual period of boiling, economy of steam, increase of yield, and an improved sugar, which points were each carefully considered by Prof. HERZFELD on their merits. He could not confirm the existence of any such advantages in any appreciable degree. He was, however, able to state that the grain formation in respect of regularity and form was considerably better than in the ordinary method of boiling whether an electrical current was used or not, which advantage is clearly shown by means of micro-photographs of grain here reproduced. Summarizing his conclusions, Prof. HERZFELD states that while " electrical boiling " as such offers no apparent advantages, the combination of Grantzdörffer's system of graining by building up on " seed " with the method of maintaining the contents of the pan in a fluid condition, and assisting circulation by drawing in syrup through a plurality of pipes in different parts of the pan, certainly constitutes a technical improvement. No effect of the current on the composition of the massecuite could be observed.

CENTRIFUGAL MACHINE DISCHARGERS. **B. B. Henderson.** *Reports of the Association of Hawaiian Sugar Technologists, October,* 1926.

In reckoning the possible gains that may be expected from the use of centrifugal dischargers, there are the questions of (*a*) the possible improvement of the sugar, and (*b*) the effect on equipment and labour. Dischargers in themselves cannot effect any change in the sugar itself, but a properly working installation should result in a lower water content, that is, a lower factor of safety in respect of deterioration, than when this apparatus is not used, when the tendency on the part of the operators using sticks and paddles is to materially lessen the labour by dropping an insufficiently dried sugar. But aside from the losses that could be prevented by bringing the deterioration factor below 0·25, there are certain gains resulting from lowering the moisture content of the sugar that may be calculated in money. These are, freight, the saving in the cost of sugar bags, and in the increased selling price of the sugar due to the increased polarization, and they amount to about $1,000 on a 10,000 ton sugar crop under average island conditions when the moisture is reduced by 0·2 per cent. One of the advantages that manufacturers of dischargers claim is that the discharging time is reduced, thereby increasing the capacity of the centrifugal. This claim is generally conceded by operators, but the use of this added capacity depends entirely on the problems of each factory. Thus, if a factory has insufficient capacity at the centrifugals, dischargers would be of advantage. Where there is enough capacity for shipping sugar, the added capacity due to the saving in discharging time might be advantageously used for drying low grades. Considering the effects that dischargers have on the equipment brings up the question of possible mechanical problems that might result from discharger installations. At several factories in the Islands where dischargers have been discarded, the reason usually given is that their use is dangerous in the hands of the labour that mans the factories, resulting in frequent breakage to screens, backing wire, and even the entire centrifugal. On the other hand, operators of successful dischargers state that, as evidence of the fact that dischargers are not hard on the equipment, they are able to use one set of screens for as long as two, and in some cases, three crops, a far longer length of service for the screens than where dischargers are not used. These two opposite results obtained from the use of dischargers seem to indicate that the cause of danger to equipment is not to be put on the discharger but on the centrifugal or the operator. In order for a discharger to function satisfactorily, it should not sway excessively and the speed should always be under control. When the plough tip is introduced into the wall of sugar, it has a tendency to start the basket swaying, and if excessive would permit the plough to gouge into the screen and backing. When dischargers are applied the speed of the centrifugal should not exceed 20 r.p.m., and unless it can easily be kept within this desired speed and always under control, it may result in tearing the screen and even wrecking the centrifugal. Dischargers in use in the T.H. are confined to two makes, with the exception of the installation at the Makee Sugar Company, which differs from the conventional type, and its simplicity, low cost and operating safety, make it worthy of special comment. It consists of a pressed steel hinge about 5 × 10 ins. that is bolted to the top of the centrifugal casing and when extended in a straight line, which is the limit to which it may be opened, one part is over the centrifugal basket. This part of the hinge has a square hole through which a steel bar is easily moved, at the end of which bar is a metal plough with a wood tip. When not in use the plough rests on the curb of the centrifugal; but in use it is swung over into the basket and pressure of the hand on the upper end of the bar keeps the plough in the sugar and the motion downward. The fact that the bar, corresponding to the spindle in other dischargers, is not held rigidly in place, is said to make it practically impossible for this type of discharger to cause damage to the screen or centrifugal.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] See German Patents, 329,590; 335,002; and 381,499; *I.S.J.*, 1924, 286. For other literature on the subject of electrical sugar boiling see: GRÄNTZDÖRFFER: *Centr. Zuckerind.*, 1926, **34**, No 9, 198; *Ibid.*, 1926, **34**, No. 12, 275-276. K. JÖRN: *Ibid.*, 1926, **34**, No. 10, 224. MAX RINGEL: *Ibid.*, 1926, **34**, No. 11, 248-249.

PLANTERS' PAYMENT OF CANE IN THE PHILIPPINES. **Herbert Walker.** *Sugar News*, 1926, 7, No. 9, 665-670.

Milling contracts in the P.I. have not worked out as satisfactorily as intended.[1] Generally it is stipulated that the Central guarantees to obtain an extraction at the mills of not less than 92 per cent., no particular boiling house recovery being specified. In Luzon 50 per cent. and in Negros 55 per cent. of the sugar produced is given to each planter " according to the weight and the analysis of his cane." Such a contract makes the price which the planter receives for his cane partially dependent on the manufacturing results obtained by the Central, and the planter has no redress so long as the average mill extraction named is realized. On the other hand, the contract is unfair to the Central in that it reduces the incentive to strive for a maximum milling and boiling house efficiency, and under such conditions it is unreasonable to expect the Central to spend as much money for improved equipment as if they were to receive all the extra sugar recovered by its use, besides which there may be times when it would be more advantageous to all concerned to mill in excess of the normal capacity, even at considerable sacrifice of extraction and b.h. recovery. A very desirable modification of the old milling contracts could be made by changing the clause pertaining to division of sugar to read somewhat as follows : " The Central will give each planter, according to the weights of his cane and the analyses of the first expressed juice therefrom r per cent. of the available sugar therefrom. Available sugar shall be determined according to the accompanying table which forms part of this contract. The distribution according to this table shall be accepted as final and not subject to correction, regardless of whether the Central may subsequently recover more or less sugar than the total available according to the table." Such a contract would be advantageous to the planter, since it would be known at once how much sugar was due to him, while the planters' representatives would be released from the necessity of continually looking out for discrepancies in manufacture and in weights of sugar actually bagged, since each planter would receive his share no matter whether the Central extracted 89 or 99 per cent., or whether molasses were run out at 30 or at 50° purity. All they would require would be a check on the cane scales, the juice sampling, and the juice analyses. The only difficulty in making such a change would be agreement as to what shall be used as a basis for determining the " available sugar," but in view of the manifest advantages to all concerned it should be possible to effect a compromise based on average factory results obtained in past years. Several Centrals have used the author's method previously described,[1] and this procedure, applying a constant correction factor of 100·4, the average for the past five seasons for the total yield of sugar from all factories, is again advocated.

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[1] See also *I.S.J.*, 1921, 623; 1922, 46, 47, 377, 438; 1923, 213; 1924, 613.

USE OF THE OLIVER FILTER IN THE CANE SUGAR FACTORY. **H. F. Bomonti.** *Reports of the Association of Hawaiian Sugar Technologists, October,* 1926.

An Oliver filter, 12 ft. long, 8 ft. diam., and having a filtering surface of 300 sq. ft., was operated at the factory of the Oahu Sugar Co., T.H., in 1925, for dealing with settlings from the defecation tanks. Previously, however, these were submitted to special treatment, viz., liming to 8·5 to 8·7 *pH*, acidifying to 6·5 *pH* with sulphur dioxide or phosphoric acid and re-limed to 7·4 *pH*, this being done in order to improve their filtrability. During the two months' run, averaging 21·5 hours per day with two hours per day for washing, 24·8 per cent. of the total settlings of the factory were filtered by the Oliver apparatus, this being equivalent to a capacity of 700 tons of cane per day, or 32·6 tons of cane per hour. A cake was obtained with an average thickness of $\frac{7}{32}$ in., of 1·14 per cent. polarization, and 83·29 per cent. water, the amount of wash-water applied being 200 to 250 per cent. of the weight of cake which latter figure was 1·09 tons per hour. This special preliminary treatment (including superphosphate) cost 20·8 cents per ton of sugar ; labour costs were 5·9 and 3·5 for filter-press and Oliver operations respectively, and the cloth expense was 7·6 and 0·8 cents.

KOPKE CENTRIFUGAL SEPARATION. **Walter E. Smith.** *Reports of the Association of Hawaiian Sugar Technologists, October,* 1926.

At the factory of the Hawaiian Commercial and Sugar Co., Kopke centrifugal separators handled the entire settlings from the Dorr clarifiers, the mechanical ease of operation and the rapid despatch of juice from settlings back to process causing a favourable impression. But the polarization of the final mud averaged 4·9 per cent. possible of reduction, only by a system of double purging, not practicable with the existing installation. As obtained, this polarization was the result of dilution of the settlings before entering the separators, not the most economical method of using water in this connexion. Including depreciation and interest costs, the centrifugal separator plant was estimated to cost 13 cents per ton of sugar, as compared with 19 cents for plate-and-frame presses, the saving of heat, and the rapid liquidation of juice from the settlings, favouring the application of this new method, as compared with that ordinarily used. But it would appear that the greatest advantage of centrifugal separation is that refractory material which would give endless difficulty with filters may be easily handled, the final polarization of the mud being positively attained without regard to fluctuations in the filtering characteristics of the settlings. Muds worked at Puunene judged by laboratory standards seemed to be more difficult to filter than any within the experience of many observers; yet, the operation of the centrifugal separators proceeded with impressive smoothness, it being merely a matter of providing adequate capacity to enable the operators to fix the polarization of the mud within any desired point within reason. A further advantage proved is that it enables one to realize the maximum benefit from the removal of " cush-cush " by means of the Peck or other strainer, this removal actually assisting the work of the separators in that it reduces the amount of solids to be eliminated. But the unfavourable factor is the greater quantity of water it is necessary to use to reduce the polarization of the mud, as to reduce to 1·5 or 2 per cent. would probably require 400 to 500 per cent. water on the mud by weight. Centrifugal separation has, however, been given sufficient trial to warrant the conclusion that it is mechanically feasible, though one must await further investigation of actual costs and savings to demonstrate the true value of this method of disposing of the settlings.

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[1] *I.S.J.*, 1925, 219.

PECTIN, AND THE DE-ESTERIFICATION OF PECTINOGEN. **Dinshaw R. Nanji and Arthur G. Norman.** *Jl. Soc. Chem. Ind.*, 1926, **45**, No. 39, 337-340T. NANJI, PATON and LING[1] have shown there are only two distinct types of pectin substances, pectinogen and pectic acid, the former being the methyl ester of the latter. Jellying phenomenon is stated by SUCHARIPA[2] to be due to partial de-esterification; by using preparations of pectinogen, and determining the methoxyl content before and after boiling for increasing periods with tartaric acid, the jellying power progressively dropped after the removal of more than one methoxyl group, so that the mono-methyl ester did not gel at all. This is the explanation why jams and jellies which have been boiled too long will not set. A volumetric method for the determination of methyl alcohol, based on the procedure of BARENDRECHT[3] was elaborated.—CONTINUOUS BOILING TO GRAIN. **C. Brendel.** *Die deutsche Zuckerindustrie*, 1926, **51**, No. 19, 554-556. Following efforts made by ABRAHAM[4] 20 years ago, this subject has been taken up by Prof. SUJEW[5] in collaboration with Prof. WOSTOKOW, operating on the principle that in saturated solutions the fine crystals forming in the upper portion of the syrup are kept near the surface by the rising bubbles of steam, only sinking to the bottom when they have acquired a certain size, where they continue to exhaust the mother-liquor, after which they may be drawn off into crystallizers for the completion of the desaccharification. Apparatus working on these lines was demonstrated at the Kapustiany s.f., Russia, under the observation of a special commission, and it was concluded that both the crystallization and the exhaustion of the molasses was as satisfactory as in the ordinary intermittent process.—SUGAR MANUFACTURE FROM DEHYDRATED BEETS. **N. Karawajew and A. Palkin.** *Bull. de l'Univ. de l'Asie centrale* (*Taschkent*), 1925, **10**, 125-28. Experiments are said to have shown that the sucrose content of beets does not suffer any appreciable inversion by a dehydration at a temperature of 60-100° C. (or in the sun) which involved a decrease of weight of 60-68 per cent., the invert sugar content being increased only 0·002 to 0·005 per cent. On diffusion in the usual plant, a juice containing 30·4 per cent. of sucrose (compared with an average of 15·5 per cent. found in the ordinary way) is obtained.—ANATOMY OF THE VEGETATIVE ORGANS OF THE SUGAR BEET. **Ernst Artschwager.** *Journal of Agricultural Research*, 1926, **33**, No. 2, 101-176. This is a critical description of the anatomical structure of the beet. It treats of the anatomy of the mature beet, the structure of the leaf, and the ontogeny of the plant.—DISCOLORATION OF FOODS PRESERVED IN TINS AND GLASSES. **Osman Jones.** *The Industrial Chemist*, 1926, **2**, No. 20, 383-384.

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[1] *J. Soc Chem. Ind.*, 1925, **44**, 253T; *I.S.J.*, 1925, 390.

[2] *J. Assoc Off. Agric Chem.*, 1923, **7**, 57; *I.S.J.*, 1923, 551.

[3] *Zeitsch anal. Chem.*, 1913, **32**, 304.

[4] SUJEW: "Encyclopaedia of Sugar Manufacture" (in Russian). Vol, IV, page 157

[5] Experimenting at the Technical High-School, Kharkov

"By far the most important factor in the trouble is faulty tin-plate, and in the author's opinion manufacturers of this commodity would be well repaid by carrying out experiments with the object of producing a plate which would possess a perfect coating of tin and also be free from alloys of iron."—Thin Juice Purification. **V. Khainovsky and J. W. L. van Ligten.** *Archief*, 1926, *Mededeelingen*, No. 6, 223-250. At Pleret, a sulphitation house, the so-called "muddy juice on bagasse" process was tried out, in 1925, this consisting in sulphiting hot the 1st, 2nd, and 3rd mill juices, heating up in defecation pans, settling, the muddy juice submitted to a second settling, and the more concentrated second muddy juice diluted with 4th mill juice which has been limed (to slight litmus acidity) and blown up with steam. This mixture (slightly still acid to litmus) was submitted to a further settling, giving "maceration juice" and "maceration clean juice," the first being sent over the bagasse from the 2nd mill, while the other juice was mixed with raw juice and passed to the measuring tank for the raw juice, in order there to be put through the clarification again. Water is used for the maceration of the 4th mill. Doubts appear to be entertained in regard to this complicated procedure, as on trying it out again at Peterongan s.f. it was decided to filter the clean juice, though after this it was proved that glucose decomposition has occurred and the juices had a high calcium content.—Crystallization of Sugar Solutions. **H. J. Waterman and A. J. Gentil.** *Chemisch Weekblad*, 1926, **23**, 345-438. Experiments are described which demonstrate that for super-saturated solutions at 40, 60, 70 and 90° C. crystallization commences and proceeds more quickly after seeding with a large (150-200 mgrm.) crystal, and the grain is finer than with a smaller crystal (0·5-2·0 mgrm.), the grain being coarser in this latter case. It is recognized that impurities may exercise considerable influence on the results.—Defects of Fehling's Solution. **R. Ofner.** *Zeitsch. Zuckerind. Czechoslov.*, 1926, **50**, 355-356, 360-364, 370-372. Fehling's solution as a reagent for the determination of invert sugars even in first product beet sugars is insufficiently reliable for the following reasons: In the presence of sucrose, oxidation occurs to an inconstant extent; being very sensitive, results depend too much on deviations of procedure which are not realized by the operator; reduction varies too much on the regularity of ebullition; there is great inclination to delay in boiling; and certain impurities have an important influence on the cuprous oxide separation.—Determination of the Surface Tension. **V. Sazavsky.** *Zeitsch. Zuckerind. Czechoslov.*, 1926, **50**, 378-380, 423-426. Using Traube's stalagometer,[1] the surface tension of saccharine solutions can be measured with sufficient accuracy provided the density is not less than 30° Brix, about which degree the figures are less certain. On the other hand, Du Noüy's apparatus, as employed by Lindfors,[2] gave results accurate only to about 10 per cent. Surface tension depends on the *pH* of the solution under examination, and the addition of alkalis considerably affects the results. A diminution of the s.t. value results on the coagulation of the albuminoids by heat; and by making use of the adsorbing power of decolorizing carbon the s.t. of evaporator syrup for example may be brought practically to the theoretical value for pure sugar.—Studies on the Coloration of Beet Juices during Evaporation. **Vl. Stanek and J. Vondrak.** *Zeitsch. Zuckerind. Czecho-Slov.*, 1926, **51**, No. 1, 1-8. An apparatus is described for reproducing in the laboratory the conditions obtaining in practice in regard to the coloration of beet juices during evaporation. Double carbonated thin-juice showed a percentage increase of colour of 70-77; but when once carbonated and once sulphited, this was only 19-21; and when triple carbonated, 30-34. Iron is shown easily to have the greatest effect of any ordinary metal on darkening during concentration.—Filtration of Carbonated Beet Juice through Wood Wool. **Franz Paulik.** *Zeitsch. Zuckerind. Czecho-Slov.*, 1926, **51**, No. 2, 23-24. Following triple carbonation, filtration, and heating to boiling, it was found on re-filtering that the bags of the Mares filters used became incrusted with a hard layer of calcium carbonate which had been thrown out of solution, passage of the liquid being thus impeded. This difficulty was overcome satisfactorily and economically by using a wood wool filter previous to the Mares.—

J. P. O.

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[1] *I.S.J.*, 1926, 441.

[2] *I.S.J.*, 1925, 653.

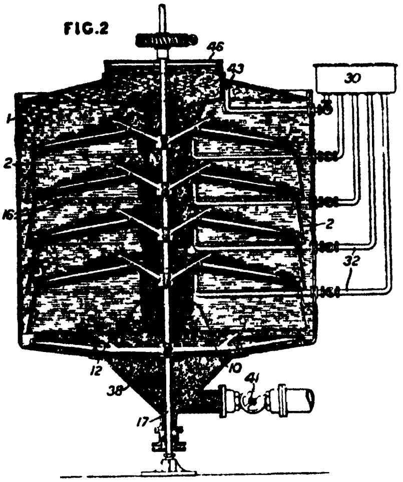
Review of Recent Patents.[1]

UNITED KINGDOM.

Settling Vessel for Separating Finely-divided Solids from Liquids.*

Joseph S. Withers (communicated by **John W. Wickes**, of Tongaat, Natal). 256,995. February 19th, 1925.

FIG.2



In a convenient form in accordance with the present invention the settling vessel or vat is provided with a number of superposed bells, the tops of the bells being downwardly dished and having at their centres a downwardly extending portion the upper part of which is of a different diameter from the lower part, so that the upper part may accommodate a spider to carry the scraping or sweeping mechanism, the spider being supported by a shaft disposed centrally of the vat and passing through the downwardly extending portions from each bell. The superposed bells which may be of the same diameter are preferably formed with sloping sides so that they can be nested together for packing and transport purposes. Alternatively the external diameter of each lower bell may be made slightly smaller than the one above it, the diameter of the downwardly extending portion or boot being slightly larger in diameter or such boot or portion may be tapered so as to permit of the bells being nested together for packing and transport purposes. This would give increasing width of the sediment space or thickness of the annular sediment compression column and there would be less tendency for the choking of the sediment, thereby giving a more uniform velocity of downward flow of the said sediment. The bells increase in diameter upwardly and may be supported by any suitable means such as brackets or equivalent secured to the outer peripheral surface of the bells and the adjacent wall of the vat. The diameter of the bells, however, is such as to leave a clear space between the bells and the adjacent wall of the vat. The depth of each bell is such that the lower edge of one bell extends somewhat below the upper edge of the next lower bell. The centrally arranged shaft may be supported in a suitable foot-step bearing provided at the bottom so as to take up the weight of the scrapers and shaft which latter preferably passes through a stuffing box at the bottom of the apparatus. Adjacent the upper end of the vat may be arranged a downwardly dished partition on which is supported a chamber for feeding the raw liquid to the apparatus, the said chamber being preferably of a considerably larger diameter than the larger diameter of the portion or boot extending downwardly from each bell top. A suitable overflow chamber is preferably arranged at the side of the vat, pipes being taken from the highest zone of each bell to the said overflow chamber. Further, a scum-collecting trough may be provided in the top of the feed chamber which may be fed by scrapers or surface sweepers where conditions render this desirable. Scrapers may be provided for keeping the bottom of the feed chambers clear of any heavy precipitate such as sand and other impurities, and the tops of the bells may be provided with man-holes closed by suitable covers, the said covers, together with all the means for securing the same being flush with the upper surface of the said bell tops. Obviously, in the above arrangement the bell tops, instead of being downwardly dished may be upwardly dished and the scrapers or sweepers may be rotated to effect central discharge of the sediment into the central space. Referring to the drawing, the settling vessel 1 is provided with bells 2 having downwardly extending central parts 10. Material under treatment is supplied to an upper compartment 46 which may be fitted with a scumming device. Sediment settles on the tops of the bells and is pushed to the centre by scrapers 16, supported by spiders 12 from a rotating shaft 17. Sediment collects in a sump 38, and is discharged through a valve 41. Liquid passes at the periphery from each compartment to the lower ones. Clear liquid is drawn off from just below each bell through pipes 32 connected to an overflow chamber 30, and from the top of the chamber 1 by a pipe 43. Sediment may be pushed to the peripheries of the bells, in which liquid passes downward at the centre. The tops of the bells may be dished upwardly instead of downwardly, as shown.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. 2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal (Patents)* with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin, Germany.

CANE HARVESTING MACHINE. **Joan J. M. Elias**, of Wassenaar, near The Hague, Holland. 255,326. January 12th, 1926.

In one of the inventor's previous patent specifications[1] a machine is described containing two fenders, or guiding walls, arranged at both sides of toothed shafts, or screws, situated at front of the machine, which fenders consist of a horizontal part and an inclined part, a groove being provided in the said horizontal part through which a cutter projects whilst a conveying band is arranged behind the toothed shafts, or screws. In a later specification[2] is a machine containing also a horizontal disc saw which can take the place of the toothed shafts, or screws. The cane stocks sliding along the outside of the fenders, or guiding walls, and not gripped by the horizontal groove are often cut by the horizontal cutters, and these cut parts fall outside the machine, thereby causing loss and the shape of the walls was such that the lying stocks were not correctly guided and drawn along the outer-surfaces of the said fenders, or guiding walls, because of the sharp corners thereon, whilst the cane-stocks sliding along the said fenders were liable to be caught and crushed by the wheels as the said wheels were not covered. Moreover, the shape of the fenders, or guiding walls, was not such that the cane-stocks drawn out of the ground by the rotating shafts, or screws, were guided properly to the conveying band. In a modification now disclosed, up-standing fenders or guiding walls are situated at each side of the machine, and are each provided with a sharp pointed forwardly-projecting stock lifting part 19 and are adapted to guide the lying cane to a cutter 4 the edge of the fenders or walls 1 extending from its forward lower part 19 below the cane cutter 4, and upwards and rearwards. The walls 1 cover the frame, wheels, etc., of the machine, and are shaped so as gradually to raise the canes lying against them. The cutters 4 are driven by a transverse shaft which drives also the conveyor of the machine. Other harvesting means may replace the main cutting or cane uprooting devices described in the above mentioned specifications.

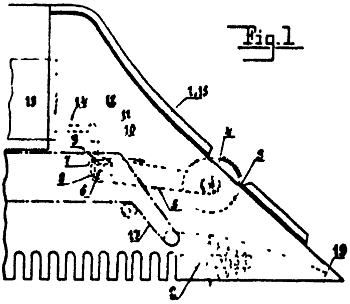
Fig. 1

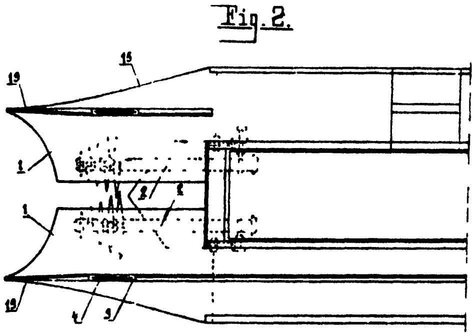
Fig. 2.

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[1] U K. Patent, 290,598; *I.S.J.*, 1926, 278. [2] U.K. Patent, 246,045: *I.S.J.*, 1926, 278.

PRODUCTION, APPLICATION AND REVIVIFICATION OF ACTIVATED (DECOLORIZING) CARBON. (*A*) **E. Urbain, of Paris.** 254,262; addition to 249,138. March 12th, 1926; convention date, June 25th, 1925. (*B*) **E. Urbain, of Paris.** 255,816; addition to 249,138. March 12th, 1926; convention date, July 22nd, 1925. (*C*) **Soc. pour l'Exploitation des Procedés E. Urbain,** of Paris. 255,871. July 21st, 1926; convention date, July 25th, 1925. (*D*) **E. Urbain,** of Paris. 257,269. August 27th, 1926; convention date, August 22nd, 1925.

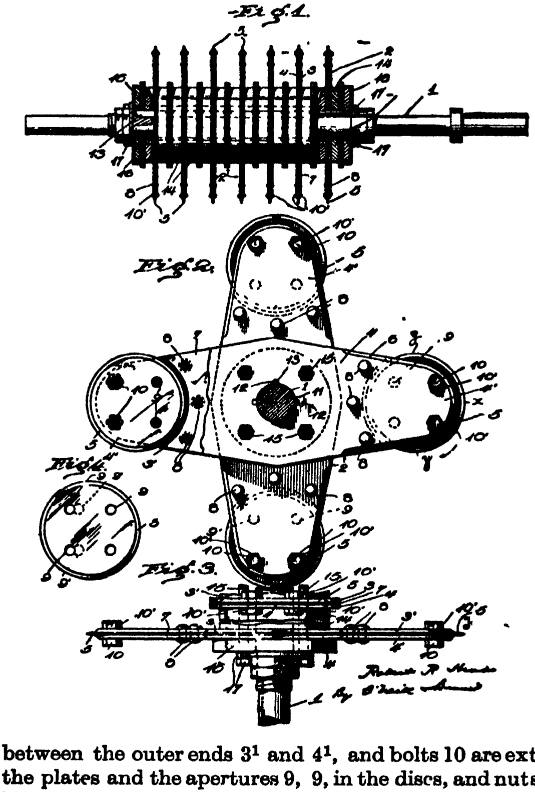
(*A*) Decolorizing carbon is obtained by carbonizing a mixture of a substance of vegetable origin, tricalcium phosphate and phosphoric acid, Fresh bones or bones deprived of organic matter may be employed as the tricalcium phosphate and the phosphoric acid which is decomposed during the calcination is collected partly as elementary phosphorus or as phosphoric acid and partly, by means of active carbon as phosphoretted hydrogen. (*B*) Decolorizing carbon is produced by extracting bones with an acid, for example hydrochloric, formic or acetic acid in order to convert the tricalcium phosphate, removing the soluble salts by washing with water and finally calcining. When sufficient acid is used, some of the calcium triphosphate may be converted to soluble monocalcium phosphate, when the phosphate content of the carbon product will be increased. (*C*) Carbon is ground in a liquid, preferably one of fairly high surface tension, whereby loss of activity during grinding is avoided, which liquid is preferably water, but oils or hydrocarbons may be used. After grinding, the carbon may be dried, preferably *in vacuo*, or may be used as a paste. (*D*) Active carbon is produced from vegetable materials by heating them with basic or acidic oxides to a temperature (1000° C. or more) sufficient to oxidize and remove the hydrocarbons present with the resulting char. In place of oxides, substances producing them or other oxygenated compounds under the conditions of the process may be used. When the oxidizing agents are too volatile to permit of adequate treatment, the process is stopped and the charge re-impregnated as often as is necessary. Zinc chloride, phosphoric acid, mono- and dicalcium phosphates and arsenic oxychloride are mentioned as suitable oxidizing agents.

INCRUSTATION PREVENTATION. **A. Kirkaldy,** of Manhattan, New York, U.S.A. 254,188. December 14th, 1925. An electrode for use in the electrolytic protection of boilers comprises a metallic tube threaded to screw into the boiler shell and adapted to enclose a conductor connecting a terminal and an anode.—ALCOHOL MOTOR FUEL. **J. Y. Johnson** (communicated by the **Badische Anilin & Soda Fabrik,** of Ludwigshafen-on-Rhine, Germany). 254,760. February 2nd, 1925. Synthesis of methyl alcohol from carbon oxides and hydrogen for the production of spirit for use for alcohol motor fuel, and the like, is accomplished with the use of various catalysts here specified.—MOLASSES, ETC., FOR PEAT UTILIZATION. **E. H. Winter,** of Bemidji, Minnesota, U.S.A. 254,994. February 16th, 1926. Peat is mixed with a caustic substance such as lime; starch or other amylaceous material; an alum; a sugar material such as glucose, refuse molasses or honey, etc.; and an oxidizing substance such as saltpetre or sodium nitrate. This mass is passed through a grinding and mixing machine, then through a pug mill or other machine from which it is extruded and cut into lengths which are air-dried forming a fibrous plastic material. A lighter product such as a cork substitute, or a material for heat insulation or packing purposes may be made, the amount of maceration being reduced and no nitrate employed.—MANURE. **J. Y. Johnson** (communicated by the **I. G. Farbenindustrie A.-G.,** of Frankfort-on-Main, Germany). 255,726. January 7th, 1926. A manure is made by mixing urea, di-calcium phosphate and a fertilizing potassium salt, preferably nitrate or sulphate. Ammonium phosphate may be added (specification 236,494 is referred to).—ALCOHOL MOTOR FUEL. **A. S. Nilson,** of Minde, near Bergen, Norway. 256,131. February 15th, 1926. Motor spirit consists of a mixture of alcohol, heavy coal-tar hydrocarbons, and " syphon-water " (an aqueous emulsion of liquid and solid hydrocarbons such as toluol, xylol, and naphthalene deposited in the distributing conduits of gas plants). In an example 500 litres of " sulphite " spirit, 2000 litres of " syphon-water " and 1000 litres of heavy tar-hydrocarbons containing benzol, creosote oil, anthracene oil, and naphthalene are mixed.—FILTER-PRESS. **F. J. Bisbee**, of Noble, Pa., U.S.A. 256,898. April 19th, 1926. A filter-press is provided with thrust devices at both ends so that separation of the plates for cleaning necessitates movement of them in one direction only. These thrust devices consist of screws operated by hand wheels, and a thrust bearing is applied to each movable head alternately, but hydraulic rams or other power or hand-driven thrust devices may be used.

UNITED STATES.

ROTARY CUTTER FOR MILLING INSTALLATIONS. **Robert H. Hind**, of Del Carmen, P.I. 1,583,150. May 4th, 1926.

Referring to the drawings, 1 indicates a rotary shaft, upon which a plurality of the cutter knives are mounted, in the manner described in the inventor's previous patent.[1] Each of the cutters comprises a blade carrier 2, composed of two co-operating plates 3 and 4 of similar shape, arranged in parallelism, and adapted to receive between them at each end, a cutter disc 5, the edges of the plates being integrally provided with a reversely-turned, integral strengthening flange 6. A liner 7 is positioned between the plates 3 and 4, serving to retain the plates in spaced relation, and a plurality of rivets or bolts 8, 8, extend through the two plates and the liner 7, and securely bind the plates together, as indicated in Figs. 2 and 3. At its outer edge the liner 7 is concaved, as shown at the left (Fig. 2) to permit of the reception of the disc cutter knife 5, within the seat formed between the outer rounded ends 3^1 and 4^1 of the plates 3 and 4. Cutter knives 5 are each provided with a plurality of apertures 9, 9 preferably arranged in pairs which are diametrically opposed, all of said apertures being equi-distant from the centre of the knife 5, similar and registering apertures being also provided adjacent the outer ends of the plates 3 and 4. In securing the knives 5 in position they are placed between the outer ends 3^1 and 4^1, and bolts 10 are extended through the apertures in the plates and the apertures 9, 9, in the discs, and nuts 10^1, 10^1, are threaded on to the bolts and securely hold the knives in position. The carriers 2 are centrally provided with a perforation 11 adapted to fit upon and closely embrace the shaft 1, each perforation being provided with a notch 12, adapted to receive a key 13 which is carried on the shaft 1, whereby to lock the carriers 2 against rotative movement with respect to the shaft 1. As many of the carriers 2 as are desired are placed upon the shaft 1, each carrier being positioned thereon so as to extend in a plane at a definite angular relation with respect to the plane of the adjacent carrier, such



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[1] U.S. Patent, 1,273,488 (1918).

relation being here shown as 90^0, but which relation may be varied at will. Between each carrier is positioned a spacer 14, for the purpose of preserving the distance between the carriers. The plates 3 and 4, the fillers 7, and the spacers 14, are all provided with a plurality of apertures spaced at equal distances from the periphery of the shaft 1, and through bolts 15 are extended through all of said apertures. Against the outer face of each of the end knives, there is preferably provided a removable washer or collar 16, which is similarly provided with an opening registering with the aligned openings in the knives, fillers and spacers, for the reception of the bolts 15. The ends of said bolts 15 are threaded, and lock nuts 17 are turned down on the ends of said bolts, whereby to firmly secure the assembled knives in position on the shaft 1. If, after four changes in position of the cutter knives 5, the entire edge thereof becomes too dull for efficient service, the knife is removed and ground to a new edge, and used as before. After repeated grindings however, and constant wear on the knife, the diameter may be so reduced that the cutting edge will not extend beyond the outer ends of the plates 3 and 4, when the bolts 10 are in the apertures 9, as heretofore explained. Under these circumstances additional apertures 9 , 9 through the knives 5 adjacent each of the apertures 9 may be provided, as shown in dotted lines, Fig. 4, and new apertures inserted.

EVAPORATION AND BOILING IN THE SAME APPARATUS. **Aquilino R. Vila**, of Havana, Cuba. 1,591,583. July 6th, 1926.

In the drawings, 1 indicates the main body of a vacuum pan provided at its lower portion with the heater body having vertical tubes 2 between which tubes the exhaust vapour of the steam engines is supplied, as is usual, said pans being supported on outer horizontal beams 3 on columns. The dome of the pan has at its interior a vertical neck 5 through which pass the vapours of the pan and which is surrounded at a certain distance by a bell 6 fixed to the upper part and concentric with the neck 5 and also spaced apart from the outer vertical wall of the dome, in which are formed horizontal outlets 7 and 8, of which the first is connected with a tube 9 which leads to the collecting tube 10^1 leading to the vacuum condenser. At the exterior of pan 1 are annexed thereto a plurality of cylindrical vertical bodies 11 which in horizontal section are of kidney shape, there being illustrated in the drawings two of these bodies, one at each side of the pan, each body 11 being fixed on horizontal beams 12 supported on columns. Each additional body 11 is closed on the top by a semi-cylindrical cap 14 and at its lower part is provided with a bottom 15 of reduced section which is provided with three openings 16, 17 and 18. The vertical body 11 is divided lengthwise by two false bottoms, an upper one 19 and a lower one 20 which consists of horizontal plates provided with perforations in which are mandrelled and fixed a plurality of vertical tubes 21 arranged in rows concentric

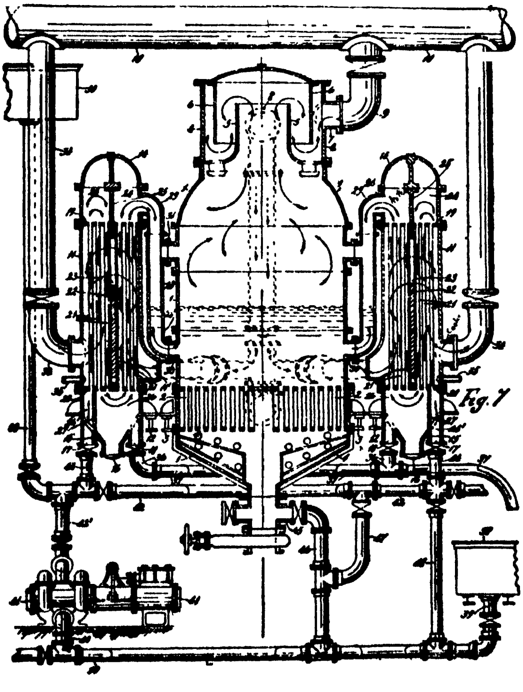
Fig. 7

with pan 1 and divided in two groups of three rows each by a vertical curved wall 22 at whose upper part is formed a large opening 23 for passing the vapours from one to the other side of said wall 22. Above the upper tube-carrying plate 19 is formed a chamber 24 for the vapours which chamber is divided in two parts by a vertical wall 25 which coincides vertically with the wall 22. Below the lower tube-carrying plate 20 is formed another vapour chamber which is divided in two parts 26 and 26^1 by a curved vertical wall 27 which corresponds vertically with the intermediate space between the first two rows of tubes 21 counted from the exterior. The inner opening 17 corresponds vertically with the narrow chamber 26^1 thus formed. Each evaporating body 11 is connected with the body 1 of the pan by means of a vertical tubular duct 28 of elongated horizontal section, which is arranged in the space between each evaporator 11 and the body 1 of the pan and is connected with an elbowed mouthpiece 29 which forms part of the inner side wall of chamber 24, and said duct is terminated at its lower end in an elbowed section 28^1 which is connected to a mouthpiece 30 of elongated section formed horizontally at the side of the body 1 of the pan, there being also tubular union of elongated section 31 between the body of pan 1 and the upper part of duct 28. From the outlet 8 provided at the side wall of dome 4, a tube 32 leads downward which is bifurcated to form two horizontal tubes 33 ending in side chambers 11^1 formed at the lower part of the section of the two evaporating bodies 11 in which is arranged the group of vertical tubes 21 which are near the pan 1. The vertical tube 32 is provided with a valve which is diagrammatically indicated by means of two crossed lines, and each of the horizontal tubes 33 is provided with a valve. From an outlet formed at the lower part of the section of each evaporating body 11 in which are arranged tubes 21 which are spaced somewhat from pan 1, leads a tube 34 provided with a valve and which communicates with the collecting tube 10 leading to the vacuum. Each evaporating body 11 is also provided above the lower tube-carrying plate 20 with a discharge tube 35 for the steam condensation. The discharge outlet 18 of each evaporator 11 communicates, by means of a tubular union 36 provided with a valve, with a horizontal tube 37 which runs around the bottom of pan 1 and serves for discharging the contents of said evaporating bodies 11 into a tank 38, from the bottom of which leads a tube provided with a valve 39 and which is connected through a tubular union 40 with a pump 41. Said pump communicates through a tube 42^1 with another horizontal tube 42, which is connected through tubular unions 43 and 44 to the outlets 17 of the bottom of the evaporating bodies 11. From the discharge outlet of pan 1 leads, in turn, by means of a tubular union 45 provided with a valve, a tube 46 which communicates with the tube 39 which supplies the pump 41, tubes 42 and 46, being connected together by another tube 47 provided with a valve, the function of which is to draw acid water used for washing the evaporators 11 without passing the same through the vacuum pan and pump. From the cross union of tube 42 within tubular union 44 leads another tube 48 provided with a valve and communicating with tube 39 which supplies the pump 41. From the tube 42 and beyond the point of communication with the pump 41, leads a tube 49 which serves for elevating the juices to a tank 50 for depositing the juices when so desired.

CENTRIFUGAL CLARIFIER. **Johann F. Meyer, Hans Lucker, and Carl Schmitz,** of Oelde, Germany. 1,595,017. August 3rd, 1926. This invention comprises a cylindrical centrifugal clarifier drum provided with a conical cover and subdivided into an interior annular preliminary clarifying chamber and an outer annular final clarifying chamber by means of an apertured partition coaxial to the walls of the drum and the cover, the arrangement of a substantially un-indented abutment member in said interior chamber and of subdivided abutting members in said external chamber parallelly superimposed upon the conical part of said partition.—SORGHUM TOPPER. **Walter Walsten,** of Inman, Kans., U.S.A. 1,596,323. August 17th, 1926. Relates to an attachment for topping sorghum for an ensilage cutting machine.—SETTLING TANK. **Lewis M. Booth,** of Plainfield, N.J. 1,595,066. August 10th, 1926. This comprises a stationary single compartment settling tank, a settling shelf of lesser diameter than said tank positioned within and above the bottom of said tank, means for rotating said settling shelf, means for supplying liquid suspension to said tank above and below said settling shelf, a scraper secured to said tank above the upper surface of said settling shelf, means for withdrawing the sediment from said tank below said settling shelf and means for withdrawing the clarified effluent from said tank at a point above said shelf.—Separation of Organic Bases and Acids from Beet Molasses. **Yoshitaro Takayama,** of Tokyo, Japan. 1,595,529. August 10th, 1926. A process of recovering organic acids and bases from beetroot molasses, consists in subjecting the same to electrolysis, and separating organic acids which collect around the anode, and bases which collect around the cathode..—Preservation of Yeast. **James H. Mackintosh,** of Jersey City. 1,596,983. August 24th, 1926. A process for preparing a dried yeast product which consists in mixing compressed yeast with a sugar-containing material, heating the mixture whereby fermentation is quickly set up causing rapid drying of the product due to the escape of fermentation gases.—Formation of Saccharate in the Steffen Process. **Ralph W. Shafor** and others (assignees to the **Great Western Sugar Co.,** of Denver, Colo.). 1,593,782. June 27th, 1926. Material under treatment, i.e., CaO and diluted molasses, are given a circulatory movement which by frequently occurring changes of direction and a consequent pulsating velocity, causes a continuous displacement of the solid phase reagent relative to the solution phase. Displacement of the powdered reagent prevents agglomeration of its particles and by maintaining the particles in separated condition and moving them continuously through the solution in search of unexhausted regions the maximum efficiency of the reagent resulting from a constant maximum effective area, is insured.—Solution of Sugar (Syrup Maker). **Herbert W. Lorenz,** of Chicago. 1,597,911. August 31st, 1926. A method is described for making a solution of sugar, consisting in agitating a liquid and subjecting a mass of solute to a suction to cause the said liquid to be sucked therethrough.—Desiccation of Liquids. **Chas. O. Lavett** (assignor to **Chemical and Vacuum Machinery Co., Inc.,** of Buffalo, N.Y.). 1,597,809. August 31st, 1926. An apparatus for desiccating liquids, comprises main casing enveloping an evaporating chamber, means for maintaining a vacuum in said chamber, a rotatable drum mounted in said chamber, means for supplying a heating fluid to said drum, a concentrator, including a plurality of removable tubes, supported by said casing and arranged to discharge inspissated liquid into said chamber and directly against said drum, means for deflecting the inspissated liquid away from said drum and returning the same to the end of said tubes distant from said drum, and closure means for permitting of optical access to said casing to permit of cleaning thereof.—Adsorptive Agent for the Purification of Liquids. **Paul W. Prutzman and Arnol D. Bennison,** of Los Angeles, Cal. 1,598,256. August 31st, 1926. An agent for the purification of liquids by adsorption, consists of magnesium silicate which has been treated with sulphuric acid and reduced to a finely divided condition.—Centrifugal Evaporator. **Martin J. Kermer,** of Chicago, Ill. 1,598,282. August 31st, 1926. Claim is made in an evaporator for a rotatable cylinder, a stationary housing in spaced and concentric relation with said cylinder, a portion of said cylinder and housing providing a steam chamber, and a portion of said housing providing an annular fluid chamber near the end of said steam chamber to seal the chamber, and bearings between said housing and cylinder beyond said fluid chamber.—Control of Boiling using a compensated Electrical Conductivity Apparatus. **Philip E. Edelman,** of New York. 1,587,106. June 1st, 1926. Claim is made for an apparatus for use in the concentration of a material, an electrode supported by an insulator, a co-operating enclosure therefor and containing numerous holes to permit passage of a fluid, means to attach said electrode to a vacuum pan, a compensator for the effect of temperature and pressure changes, a calibrated resistance member associated with said electrode and graded in terms of the concentration of the material undergoing treatment in said vacuum pan, an associated resistance member to correct said calibration for variations in the initial condition of said material, and indicating means connected therewith to show the corrected contration in said treated material.

Sugar Crops of the World.

(Willett & Gray's Estimates to November 4th, 1926.)

	Harvesting Period.	1926-27. Tons.	1925-26. Tons.	1924-25. Tons.
United States—Louisiana	Oct.-Jan.	103,000	124,447	79,002
Texas	,, ,,	—	—	—
Porto Rico	Jan.-June	530,000	544,484	589,760
Hawaiian Islands	Nov.-June	714,000	705,350	692,804
West Indies—Virgin Islands	Jan.-June	6,000	7,000	7,200
Cuba	Dec.-June	5,000,000	4,884,658	5,125,970
British West Indies—Trinidad	Jan -June	70,000	73,561	69,628
Barbados	,, ,,	50,000	47,535	49,315
Jamaica	,, ,,	50,000	57,675	42,843
Antigua	Feb.-July	14,000	12,800	17,300
St. Kitts	Feb.-Aug.	14,000	16,380	15,563
Other British West Indies	Jan.-June	6,000	7,500	6,253
French West Indies—Martinique	Jan.-July	45,000	48,121	47,995
Guadeloupe	,, ,,	40,000	40,000	39,990
San Domingo	Jan.-June	335,000	354,720	311,270
Haiti	Dec.-June	12,500	11,249	8,280
Mexico	,, ,,	175,000	190,282	165,223
Central America—Guatemala	Jan.-June	33,000	25,151	25,562
Other Central America	,, ,,	70,000	62,500	73,240
South America—				
Demerara	Oct.-Dec. and May-June	95,000	107,580	90,874
Surinam	Oct. Jan.	13,000	10,000	10,200
Venezuela	Oct.-June	19,000	19,000	20,625
Ecuador	Oct.-Feb.	18,000	16,976	18,700
Peru	Jan.-Dec.	275,000	265,000	310,522
Argentina	May-Nov.	440,000	395,733	246,717
Brazil	Oct.-Feb.	700,000	650,000	812,493
Total in America		8,827,500	8,677,702	8,877,329
Asia—British India	Dec.-May	3,000,000	2,923,000	2,548,000
Java	May-Nov.	1,936,000	2,278,900	1,977,490
Formosa and Japan	Nov.-June	450,000	498,460	458,836
Philippine Islands	,, ,,	500,000	425,000	581,064
Total in Asia		5,886,000	6,125,360	5,565,390
Australia	June-Nov.	425,000	522,344	435,680
Fiji Islands	,, ,,	85,000	90,000	100,810
Total in Australia and Polynesia		510,000	612,344	536,490
Africa—Egypt	Jan.-June	90,000	95,000	79,918
Mauritius	Aug.-Jan.	195,000	241,220	224,710
Réunion	,, ,,	50,000	59,015	52,380
Natal	May-Oct.	223,000	213,807	143,974
Mozambique	,, ,,	65,000	70,000	44,278
Total in Africa		623,000	679,042	545,260
Europe—Spain	Dec.-June	7,500	9,000	8,087
Total cane sugar crops		15,854,000	16,103,448	15,532,556
Europe—Beet sugar crops		7,111,000	7,435,451	7.079,589
United States—Beet sugar crop	July-Jan.	860,000	804,439	974,185
Canada—Beet sugar crop	Oct.-Dec.	30,000	32,475	36,200
Total beet sugar crops		8,001,000	8,272,365	8,089,974
Grand total Cane and Beet Sugar	**Tons**	**23,855,000**	**24,375,813**	**23,622,530**
Estimated decrease in the world's production	,,	505,150	*753,283	*3,506,421

* Increase.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1926 Tons.	1925. Tons.
Total Receipts, January 1st to October 27th	2,912,429	2,896,285
Deliveries ,, ,,	2,759,700	2,871,003
Meltings by Refiners ,, ,,	2,755,000	2,826,380
Exports of Refined ,, ,,	68,250	254,000
Importers' Stocks, October 27th	161,385	25,282
Total Stocks, October 27th	210,363	81,712
	1925.	1924.
Total Consumption for twelve months	5,510,060	4,854,479

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924. Tons.	1925 Tons	1926 Tons.
Exports	3,512,100	4,082,059	3,715,725
Stocks	273,426	639,439	603,469
	3,785,526	4,721,498	4,319,194
Local Consumption	100,000	107,000	110,000
Receipts at Ports to September 30th	3,885,526	4,828,498	4,429,194

Havana, September 30th, 1926.

J. GUMA.—L MEJER

Beet Crops of Europe.

(Willett & Gray's Estimates to October 21st, 1926.)

	Harvesting Period.	1926-27. Tons.	1925-26. Tons.	1924-25. Tons.
Germany	Sept.-Jan.	1,800,000	1,595,545	1,575,684
Czecho-Slovakia	Sept.-Jan.	1,200,000	1,485,031	1,411,101
Austria	Sept.-Jan.	80,000	77,630	75,443
Hungary	Sept.-Jan.	185,000	163,332	202,354
France	Sept.-Jan.	700,000	756,038	834,138
Belgium	Sept.-Jan.	280,000	332,170	400,105
Holland	Sept.-Jan.	300,000	303,365	329,244
Russia (Ukraine, etc.)	Sept.-Jan.	1,000,000	1,041,903	458,375
Poland	Sept.-Jan.	600,000	590,000	494,854
Sweden	Sept.-Dec.	25,000	204,500	135,270
Denmark	Sept.-Jan.	150,000	179,998	140,995
Italy	Aug.-Oct.	270,000	162,000	422,429
Spain	Sept.-Jan.	300,000	243,939	252,040
Switzerland	Sept.-Jan.	6,000	6,395	5,906
Bulgaria	Sept.-Jan.	30,000	38,000	39,758
Roumania	Sept.-Jan.	125,000	110,000	86,256
England	Sept.-Jan.	143,000	51,140	23,730
Other Countries	Sept.-Jan.	125,000	94,465	191,907
Total in Europe		7,319,000	7,435,451	7,079,589

United Kingdom Monthly Sugar Report.

Our last report was dated October 8th, 1926.

We have again experienced steady markets and improving prices throughout the whole period under review, and values generally—especially for white sugar—are dearer.

The London Terminal Market has been much more active and a very large business has been transacted; on one particular day the registrations in London reached the record figure of 30,000 tons. About 15,000 tons were tendered in fulfilment of October contracts, and business was done in this month from 14s. 10½d. to 14s. 6d. to 15s. By far the largest business was done in December which moved from 15s. 4½d. to 15s. to 15s. 9d. This latter figure being chiefly caused by large covering orders from Continental countries. Much more interest is being shown in forward positions and the speculative demand for the 1927 months is causing the premium to widen. March sold from 15s. 9¾d. to 15s. 4½d. to 16s. 4½d.; May sold from 16s. to 15s. 7½d. to 16s. 7½d.; and August from 16s. 6d. to 16s. 2¼d. to 17s. The latest prices are November 15s. 5¼d.; December 15s. 6¾d.; March 16s. 3d.; May 16s. 6d.; and August 16s. 9¾d.

Trading in actual sugars has been in good volume and it appears that the trade are altering their hand to mouth policy by very cautiously buying a little ahead of their actual requirements. Ready sugar has continued to be scarce and the value has risen to 16s. 4½d. f.o.b. Hamburg and 16s. 7½d. f.o.b. Rotterdam. November/December sold from 15s. 7½d. to 16s.; April/May sold up to 16s. 10½d.; and March/August 17s. 1½d. Germany has not been in the market as a seller. Spot Sugar has improved and Granulated sold from 28s. 6d. to 29s. duty paid terms, and a good business has been done.

Home Grown sugar is being marketed steadily at better prices. The lowest price done during the month was 29s. 6d. ex London depot, and since then the price has advanced to 29s. 10½d. The latest prices are 29s. 10½d. to 30s. 6d. according to factory and quality.

The British Refiners made several alterations in their prices. On October 18th all standard marks were reduced by 6d. per cwt.; on October 25th prices were advanced by 3d. with the exception of Empire Granulated which was raised by 6d. per cwt.; on November 4th the price of Empire Granulated was raised by 3d., and a further advance of 3d. was registered on November 9th. The latest prices are No. 1 Cubes 35s.; London Granulated 30s. 10½d.; Empire Granulated 30s. 6d.

On October 25th it was announced that one of the London Refineries was closing down and the other one working half time. Apparently this drastic step was taken by the Refiners in consequence of the small margin between raw and refined. The Refiners have accumulated large stocks of Refined and until these are worked off they will probably not start refining seriously again.

In consequence of this action they have not been in the market for raws. A small business, however, has been done to Liverpool and to the Continent at 13s. 6d. to 13s. 9d. ci.f. Owing to the coal strike causing freights to increase the nominal price of Cuban 96 per cent. is 14s. to 14s. 6d.

In New York a fairly large business in raws has taken place, the price moving from 2⅞ to 2¾, and later to 2 13/16ths at which price business is doing to-day. Several Cuban cargoes have again been sold to the Far East.

The Futures Market has moved more or less in accordance with actual sugar, but December has gone to a bigger discount against forward months.

F. O. LICHT has adjusted his estimate for the European Beet crop and his total figure is now 7,343,000 tons. Messrs. Willett & Gray have also issued an estimate of 7,111,000 tons. This latter figure would give a reduction of 350,000 in the European production.

Reports from Czecho-Slovakia are not at all encouraging and it is considered in some quarters that this crop will not be over 1,050,000 tons, against 1,490,000 tons last year.

A serious hurricane visited Cuba on October 21st and considerable damage was done to the western part of the Island. Although it is difficult to estimate the actual extent of this damage it is generally accepted by prominent authorities at about 2/300,000 tons. No further restricting conditions have been imposed and taking into consideration the damage done by the hurricane, and the fact that refining will not start before January 1st, 1927, Messrs. Willett & Gray estimate the next crop at 5,000,000 tons.

The exports from Cuba have continued to be large and the total stock in the Island is now only 566,000 tons against 522,000 tons last year.

Messrs. Willett & Gray have estimated the production of the world for next year at 23,850,000 tons. This would be a reduction of 505,000 tons on last year.

21, Mincing Lane,
London, E.C. 3.
November 11th, 1926.

ARTHUR B. HODGE,
Sugar Merchant and Broker,

THE
INTERNATIONAL SUGAR JOURNAL

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable ; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 336. DECEMBER, 1926. Vol. XXVIII.

Notes and Comments.

The 1927 World's Sugar Crops.

Since our last issue the Cuban President has taken the definite step of decreeing that the present growing Cuban crop shall be restricted to 4,500,000 tons. At the same time nothing has been announced to alter his previous decision that cutting shall not begin before January 1st. The sugar market is therefore faced with the prospect not only of there being hardly any carry-over in Cuba at the end of the year, but also of the next Cuban crop being less than the last one by approximately 385,000 tons. As a result of this decision, Messrs. Willett & Gray reduced their estimate of the world's crops for 1927 to 23,363,000 tons, compared with 24,266,442 tons last campaign, or a decrease of 1,003,442 long tons. We give on another page their last estimate to hand at the time of writing. It must be explained, however, that even this does not include the later reduction forecasted in the European beet area. If this be allowed for, the world's decrease will be approximately 1,130,000 tons.

It is assumed that as the Cuban Crop Restriction Law is still in force and it gives the President discretion to curtail the new crop by a maximum of 10 per cent., he has taken the total of the growing crop as equal to five million tons, the figure at which Willett & Gray put it. But other authorities were inclined to put it, if unrestricted, as high as six million tons, and our Havana Correspondent some months ago indicated that Cuba would be capable of that output, to judge by the planting commitments. There is, of course, the consideration that the recent hurricane damaged the crop to the extent of at least a quarter of a million tons ; but, even allowing for that, the maximum crop output of Cuba, if the higher estimates proved right, would indicate a much greater restriction in sugar produced than the 10 per cent. of five million tons.

Although the sugar market has known for a month or two that the 1927 output was going to show a decrease as compared with 1926, it was naturally not expected that the figure would exceed a million tons. Meanwhile existing stocks in London and New York were too excessive to encourage an early rise in prices. But following on the Cuban Presidential announcement, the market for " Futures " in America rose some 40 points by the beginning of December and sellers were wanting as much as 3⅜ cents c. and f. The carry-over in Cuba at December 31st now promises to be less than anticipated. Czarnikow's Circular gives the total old crop sugars available from November 27th to December 31st, as 321,430 tons as compared with 607,953 tons last Christmas, a shortage of about 280,000 tons, while there is not this year a portion of the new crop available, whereas in 1925 252,457 tons had come on the market by December 31st. The probable shipments from Cuba during December are put at some 300,000 tons, and if this eventuates, it will leave Cuba with practically no carry-over. The new year will therefore start with the sugar markets in a much healthier position and prices should rule considerable higher than in 1926.

The European beet crop has steadily disappointed the statistical prophets this Autumn, owing to the unfavourable weather and other adverse factors on the Continent. At the beginning of October Licht made his first forecast, which was 7,340,000 metric tons. Later he raised it by 2000 tons, but at the beginning of this month he had reduced the crop to 6,983,000 tons, thanks chiefly to Germany's crop being less by 125,000 tons than was anticipated, and Czecho-Slovakia's less by 150,000 tons. The latter country's deficit as compared with 1925-26 is no less than 450,000 tons. Elsewhere we give Licht's figures in detail, as published at the beginning of the month. But we may remark that it is a very long time since the crop estimates issued annually in the late Autumn were subjected to so many abrupt changes from week to week as has been the case this year ; and even now one is not sure whether the figures given in the foregoing notes are going to stand for what may be described as the final " preliminary " estimates.

Production and Consumption.

Of late months a number of writers have essayed to forecast the trend of consumption and production in the sugar world. One of the most interesting has been that of Mr. Lee Camp of Havana. We have not space to give it in detail, but what follows is an interesting and instructive summary of his arguments by a German statistical writer (Mr. J. Humbert of Magdeburg) who makes the pertinent observation that the war period broke up the pre-war production and consumption line, and it is necessary to adjust the new one to a new level. Mr. Humbert writes :—

" In May, 1925, on the occasion of the Magdeburg sugar exhibition, a highly interesting diagram was exhibited by Messrs. Runge, Bacmeister, Lamborn & Co., Hamburg, showing the development of the world sugar production during the period from 1886/7 to 1913/4 and indicating by a line, that which was probably the actual sugar consumption of the world during that period. It was shown that during those 27 years the consumption had increased at the rate of 4 per cent. per annum. The conclusion to be drawn from that diagram was that, had the increase of consumption continued at the same rate from 1913/4 to 1925/6 then the world's sugar production of the latter campaign would have been over four million tons short of the consumption.

" A very similar diagram has since been published by Mr. Lee G. Camp, of Havana. Both diagrams, though apparently made up independently, show the same very interesting relationship between the variations of production from the normal consumption line and prices. Mr. Camp starts back from 1850/1 and finds the normal yearly increase of consumption to be 3·8 per cent. He adds some very interesting hints regarding the probable further development of consumption, and expresses the opinion that in 1934/5 the world's consumption will once more have reached the normal line and will then amount to 36,960,000 tons.

"According to his showing the first five years of the period of re-adjustment were completed in 1924/5, consumption having then approached to within 14 per cent. of the normal as compared to a deficiency of 30 per cent. in 1919/20. During these five years the annual increase of consumption has been 8·1 per cent. on an average, and Mr. CAMP'S opinion is that during the following ten years the annual increase of consumption starting from 6·4 per cent. will gradually return to 4 per cent.

"The only objection which may be raised to these interesting explanations is, whether it can really be expected that the actual consumption of the alleged period will increase above the normal rate. In order to balance the total of the very large real deficiencies in the comsumed quantities during the war, this would however be indispensable. In fact, it seems necessary to realise that the future consumption normally will not reach the continued pre-war line, but that the old normal line must be replaced by a new lower one, which then, of course, would be reached earlier.

"Whilst Mr. CAMP is inserting a yearly increase of 1,446,000 tons, others think it safer to calculate only one of 1,200,000 tons. If this rate, which seems to be a fair one, should be taken as the rate of gradation, it would represent an increase of 5·3 per cent. and reach the normal increase of 4 per cent. in seven years, i.e., in 1931/2 with 29,700,000 tons, against Mr. CAMP'S contemporary 32,622,000 tons. In that case the difference of 2,922,000 tons would mean the span between the old and the new normal line. Of course both heightening rates are guesswork and may miss the mark, or the middle course may prove to be the best, yet the apparently fair figure is selected to elucidate the main future.

"In view of the great interest which Mr. CAMP'S figures have met with it seems, however, worth while stating that Messrs. Willett & Gray's last estimate of the world's crops of 23,363,000 tons (including Cuba with 4,500,000 tons) is by about 2,000,000 tons lower than Mr. CAMP'S consumption figure for 1926/7, by about 1,500,000 tons lower than the figure found by a gradation of a yearly 1,200,000 tons, and probably also lower than most other conservative estimates."

Beet Sugar Affairs at Home.

The 1926 beet sugar crop at home has from all accounts been quite satisfactory. Though not coming up to the bulk expected a few months ago, it has made up in sugar content for what it has lacked in quantity, the roots all over the country being unusually rich in sugar. The weather too has been more favourable to gathering and transporting the crop than it was last year ; and whereas in 1925 the manufacturers complained that the deliveries were dilatory and hampered the economic running of the factories, the case has been the opposite this year, and the farmers have been inclined to grumble that the factories could not take delivery as fast as the growers desired. Of course the lesson has had to be learnt that deliveries must be neither tardy nor in excess ; the factories must be fed evenly. It has been found necessary, owing to pressure of offers of roots, to request the farmers to clamp their beets for a time pending ability to slice them at the factory.

The latest reports with regard to projected new factories indicate that both the Pulborough (Sussex) and Bletchley schemes have been abandoned, the former because there was not adequate effluent discharge without affecting fish streams, and the latter because Government assistance under the Trade Facilities Act is no longer forthcoming. On the other hand, Selby crops up again as the venue of a new factory. Originally the Anglo-Scottish group planned a factory here, but afterwards abandoned the project. Now it is announced that the Central Sugar Co., the owners of the Peterborough factory, are planning to erect a factory on the River Ouse at Selby and have already secured a site and a promise of some 2000 acres out of the 5000 needed. Yeovil factory scheme having been abandoned by its promoters, the Anglo-Dutch group, the latter are looking out for a suitable site for a factory in the south or south-eastern counties, and the Portsmouth district has been suggested as a likely place. The Savernake and Didcot projects seem to be still in the air, but negotiations have not been abandoned as yet.

Sugar Production in the Leeward Islands.

The fifteenth annual report of the St. Kitts (Basseterre) Sugar Factory Ltd. for the year ending September has just been issued, and shows what can be done by small but progressive sugar concerns under the difficulties of low prices. The output of sugar was satisfactory, being 16,290 tons (as compared with 14,061 tons in 1924-26)[1] derived from 143,552 tons of canes. The purity of juice, at 82·93, was the lowest for the past six years, but the recovery of sucrose in cane was 87·64, a figure only slightly below the highest yet obtained. The yield of 96° sugar was 11·34. The average price obtained was only £13 7s. 1d. per ton or nearly £4 a ton less than in 1924-26.[1] After charging revenue with £18,084 to meet interest and other charges, a surplus remained of £22,175 which is divided between the original contractors and the shareholders, the latter receiving the equivalent of about 8 per cent. on their investment.

The first fifteen years of the Company's work, the period covered by the agreements with the planters and the "A" debenture holders, are now on the point of being completed. A brief review of the main points of the Company's history for this period may therefore be of interest. The factory was erected with a view to an output of 8000 tons of sugar yearly, say about half the production of the island, but part of the plant of a size that could deal with a considerably larger quantity, and its cost, including railway, was £157,570. Estates that lay outside its first limits were brought in from time to time, and now the whole of the canes in the island are sent to it. Additions have been made which will enable the Company to produce 18,000 tons of sugar and the additional capital outlay for this has brought the total cost up to £281,746. The railway which is 40 miles in length, including sidings, was difficult and expensive work owing to the irregular contour of the land, deep ravines having to be bridged and rocky ridges to be cut through. The factory plant was supplied by the Mirrlees Watson Co., Ltd., and it has given entire satisfaction throughout.

During the fifteen years the factory has ground 1,230,176 tons of cane which have yielded 140,884 tons of sugar, taking 8·70 tons cane to the ton of sugar. The yield in the muscovado boiling-houses in St. Kitts was reckoned at 14 tons cane to the ton of sugar, on which basis these canes would have given only 87,869 tons sugar. Thus the factory through better work has gained 53.015 tons of sugar, which, at the average sale price of £19 6s. 1d., has realised £1,023,410. The price paid to the planters for canes, including the bonus, has averaged 23s. 5d. per ton, or fully 6 per cent. on the sale price of the sugar, and the Company has provided free transport of canes at a cost to it of 3s. 3d. per ton. The redemption of the balance of the " A " Debentures will be completed on 15th December. The " B " Shares will then be distributed to the Planters in accordance with the agreement, and the payments against canes during the season 1927 and thereafter will be raised to 5½ per cent. with bonus as hitherto.

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[1] Acreage of three years.

Philippine Sugar in the 1925-26 Season.

Mr. GEORGE H. FAIRCHILD, of the Philippine Sugar Association, in his annual report on the Philippine sugar crop—that for 1925-26—states that this was the largest cane crop ever harvested. Almost all of the sugar mills, especially those on Negros, were taxed to their utmost capacity, and milling had to be extended to two, and in some cases, even three months beyond the usual date for closing. The planters worked the labourers and animals overtime in harvesting the bumper crop, with the result that the 1925-26 crop did not receive proper care in planting, cultivation, and fertilization, as in many instances planting continued until late in the season, shortage of work animals and implements restricted cultivation operations, and fertilizers that should have been applied earlier in the season were applied too late. While these difficulties contributed to the shortage of the 1925-26 crop, the unfavourable weather conditions throughout the milling season were equally responsible for the shortage. In some districts, financial difficulties were also a factor in that they curtailed the planters' cultivation operations. The output of centrifugal sugar amounted to 379,022 metric tons, as compared with 499,291 tons in 1924-25, and 316,181 tons in 1923-24. This means that the crop was 24 per cent. less in sugar output, as compared with the previous season. This was due to a lesser yield per hectare : the 1925-26 average was less than 60 piculs, which compares with 75·77 piculs in 1924-25, and 60·50 piculs in 1923-24.

The prospects for the 1926-27 crop are good, as the weather conditions so far have been very favourable and free from floods and storms. If this factor continues, a bumper crop may be obtained, and Mr. FAIRCHILD tentatively estimates coming production at 498,000 metric tons.

South Africa : Millers' and Planters' Agreement.

A protracted conference between the sugar millers and the planters of South Africa, which has lasted for months, was finally ended on September 4th and an agreement was signed which places the payment for cane delivered to the mills in that country on a more equitable basis for both parties and encourages the production of quality and not merely quantity. Payment for cane will now be made mainly on the sucrose content, and proper testing laboratories will be obligatory at the sugar factories. The agreement in fact follows the recommendations of the Board of Trade's Report which laid down that the percentage of sucrose and purity of juice, as well as the actual weight of the cane, should be factors in determining the price to be paid by the mills.

It would appear that the average price for 96° raw sugar for export and local refining for each year, beginning on May 1st, shall be determined, and the local refining price is to be not less than 75 per cent. of that. These being ascertained, the planter will receive payment in accordance with the chemist's scale, his season's average sucrose being the determining factor. Cane will be paid for at the rate of 90 per cent. and its provisional value on the due date, the remainder being paid at the end of the accounting year. The surplus profit of the refineries after meeting all expenses and paying 8 per cent. cumulative interest on the capital will go to the raw sugar suppliers in final payment for their sugar. On the new price basis, we gather, sugar will be sold at £22 per ton refined and the planters will get 17s. per ton for their cane on the basis of 13 per cent. sugar content.

The general effect of the new agreement is summed up by the *South African Sugar Journal* as follows : "It is the universal opinion that the new arrangement will enormously increase the potentialities. while at the same time stabilizing the Industry, and affording it greater scope for expansion. The most important feature, which forms the foundation stone of the agreement, is the arrangement entered into by all the mills, outside of the C. G. Smith group, to make only cargo sugars for the refinery, and to sell the whole of the production through one agency. This will eliminate cut throat competition and ensure the manufacture of a high standard of white sugar and eliminate many sources of waste existent in the past. It will also give the planters a higher price for their cane, and the millers a more remunerative price for their sugars, and enable them to maintain their mills at a higher standard of efficiency. Payment for cane according to the sucrose content will ensure the production of better cane and simplify the milling operations, while the elimination of various selling agencies will save money to the Industry."

Power Alcohol within the Empire.

In addition to the recommendations to the Imperial Conference referred to last month[1] the British Empire Producers Organization has also put before the Conference recommendations with regard to the present lack of development of power alcohol resources within the Empire. Liquid fuel is the only essential commodity in which the British Empire has not in clear view the possibility of providing for its own needs. In the opinion of a Government Committee which went into the question not long since there is a grave danger of a permanent world famine in motor spirit, and the only ultimate solution of the problem is the production at home and overseas of power alcohol.

All mineral sources of liquid fuel are exhausting sources ; but vegetable matter, the raw material of power alcohol, perpetually renews itself, and that renewal can be systematized and stimulated. A start has been made in South Africa and some Crown Colonies, but a well defined Empire policy is necessary for the encouragement of capital and enterprise. A movement was set on foot in Great Britain a short while ago to create an alcohol industry distilling from beets during the beet season and from raw materials imported from overseas during the rest of the year. But the subsidy granted to home grown beet sugar precludes the diversion of beets to alcohol distillation unless and until the subsidy is extended to beets destined for alcohol manufacture. The British Power Alcohol Association (of which Lord DENBIGH is President) is endeavouring to secure this reform ; but the Government have just recently expressed the opinion (in Parliament) that an alcohol industry at home could not be made to pay under present conditions even with the same subsidy as beets get. The major function of the Association is, however, to encourage the development of power alcohol industries throughout the Empire and to assist with technical information relating to the subject ; and doubtless its activities will be concentrated along this line in the near future.

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[1] *I.S.J.*, 1926, 575.

Fifty Years Ago.

From the "Sugar Cane," December, 1876.

In this issue of our predecessor there was little of interest technically, most of the space being devoted to reports of the sugar conferences then taking place in Paris with the view to urge the reduction of the bounties that were so seriously menacing the refining trade at home. There were a few abstracts of patents, British and American, however, that still appear to have some little historical interest.

A system of affining raw sugars was protected by Alex. Scott, Jr., and Thos. R. Ogilvie,[1] which was here described as follows : To 100 parts of beetroot sugar, 10 to 15 parts of water are added, or in the case of cane sugar, a smaller quantity. When well mixed, the whole is placed in a centrifugal machine, and the liquid thrown off. While in the centrifugal, a dose of saccharine liquid of 2½ to 10 parts is added. The sugar remaining in the centrifugal is freed from saline solution, and the effluent liquid is boiled and jellied. Hippolyte le Play, of Paris,[2] had a process of defecating saccharine solution. " He mixes a compound, composed of three parts of dicalcic phosphate and one of sodic phosphate, with the saccharine solutions, before the lime for defecating is added. Usually 2 lbs. of the compound will suffice for 220 gallons of saccharine solution. The compound is said to obviate the following evils : First, the formation of soluble salts of lime by its combining with free acids to saturation ; and second, the reaction of the lime on uncrystallizable sugar, so as to form a dark-coloured free acid and salts." Thirsky L. Wadsworth, of Sacramento, California,[3] specified a machine for compacting loose granular sugar into cubes, the moulds in which formed a cellular wheel, this revolving in a casing beneath a hopper, so that as the said wheel revolved beneath the hopper, each cell or row of cells in its circumference became filled with sugar. A revolving curved vane in the hopper aided the filling, and two rollers still further compressed the sugar into the moulds. A piston formed the bottom of each mould, the piston rod sticking out into the interior of the said drum, acting on knobs on the ends of the pistons, forced the sugar blocks out, as it arrived at the bottom of the drum on to a travelling band. Albert de la Montaigne, of New York,[4] described a somewhat similar mode of operating. James Mallon, of Baton Rouge, Louisiana,[5] disclosed a 3-roller mill with a perforated steam-pipe in front of the receiving rollers, and one or more perforated steam-pipes in the cane knife for forcing small steam jets up through the cane as it passes over the knife or turn-plate. The bagasse roller was adjustable to suit the varying quantity of stuff passing through, the inventor claiming that " bagasse is more thoroughly drained of soluble matters than can occur in any other way at present known." Charles H. Hersey, of Boston,[6] protected an apparatus for cooling animal charcoal, consisting of an outer drum, placed in an inclined position, and driven by a toothed wheel, taking into a cogged rim on the drum. Inside the drum was a number of radial shelves, which lifted up the charcoal as the drum revolved. Within the drum was a cooling cylinder, consisting of a series of pipes arranged to form chambers, and within the series of pipes was a shell to prevent the charcoal passing between the pipes. Water flowed through a pipe into a chamber, and thence through the cooling pipes and was discharged from a chamber at the other end of the drum.

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[1] English Patent, 1054 of 1876.
[2] American Patent, 181,856.
[3] American Patent, 181,883.
[4] American Patent, 181,920.
[5] American Patent, 182,377.
[6] American Patent, 182,823.

The Scientific Study of Irrigation in Hawaii.

Judging by the number of papers devoted to it, which were presented at the Annual Meeting of the Sugar Technologists of Hawaii, irrigation appears to be the question of the moment in the cane industry. And this is not to be wondered at, when we consider its extraordinary development in the islands during the past quarter of a century, and its increasing importance in the economics of cane growing. In spite of a favourable home market within easy reach, Hawaii must be feeling the effect of the present wave of depression passing over the sugar industry in the tropics. But there do not appear to be any hysterical lamentations on that account. On a similar occasion quite recently, it will be recalled that the impending crisis was met by the challenge of " more investigation, more experimentation, more research, leading to higher yields per acre and lower costs per ton," and attention was focussed on the plantation side, with this end in view.[1] And that attitude appears to have remained unchanged ever since ; there was never any question of reducing the scientific staff or cramping its work by decreasing the annual budget voted for the purpose.

The equipment of the sugar industry in Hawaii is the most costly of all cane sugar countries. For, besides keeping the factories thoroughly efficient, an expensive imported labour is employed, the manuring of the fields is on a lavish scale, and vast sums are locked up in irrigation works. The fields are plentifully supplied with water, whether there is a good natural rainfall or not ; and, to meet the threatened deficiency, an ambitious campaign of tree planting has been inaugurated for the better conservation of the abundant rains that fall. In places, the subterranean stores of water are being explored and utilized by means of costly pumping plants : since this water is often somewhat brackish and saline, it appears quite possible that the planters have even called in the sea and harnessed it to aid them in their work. For the working out of the details of these various projects, a thoroughly efficient staff of experts in various sciences is employed, and it is their duty also to overhaul all branches of cane growing and cultivation, from the selection of the seed to the handing over of the crop at the mills. It is characteristic of such work that various problems are taken up in turn, and the united efforts concentrated on them : such are the former fight against insect pests, the more recent mycological work, the raising of seedling canes, efforts to increase the yield by bud selection ; the investigation of stock, and their rational and economic feeding, transport and harvesting problems ; surveying the forests and the reservation and enclosure of portions to protect them from further damage, the selection of the most suitable types of trees for re-afforesting the depleted slopes of the watersheds and decaying forests, bringing the appropriate wasps from the east for the fertilization of the fruitless fig trees, and so on. Besides these, the whole range of soil studies, including detailed soil maps for many estates for manurial purposes, and studies of the relation of the soil constituents to the healthy growth of canes, and their effect on the growth of fungi and other diseases. These and many other " projects " have been and are being investigated in turn. But the purely scientific aspect has not been allowed to dominate, for the staff of experts is employed by the planters themselves, and the closest relations are kept up between the two bodies. In fact, most valuable experimental work is constantly done by the planters themselves, both at the suggestion of the scientific staff and on their own initiative. And all this costs money, which is freely allocated by the owners of the plantations and factories.

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[1] *I.S.J.*, 1922, p. 396.

The Scientific Study of Irrigation in Hawaii.

There are great variations in the soils and climatic conditions of the different parts of the Territory, and there appears to be little danger of the plantation practice being hampered, by the stereotyping which is so common in less developed sugar growing countries. Thus a multiplicity of methods is being practised, the character and results of which are freely communicated by one planter to another, and discussed in general meetings held for the purpose. There is thus an incentive for the staff of each plantation to specialize for its own particular conditions, after testing and judging the advantages and defects of methods employed elsewhere. A friendly rivalry in plantation work is characteristic of Hawaii, and in this respect there is a close analogy to the work being done in Java, another great sugar producing island in the tropics, where a large scientific staff is employed and controlled by the planters themselves. And yet, the basic conditions of plantation work in Hawaii and Java could not well differ more widely than they do, and little can be learnt by one from the other. It is well to place the fine results obtained in these two extreme cases before us ; for it would be a tenable hypothesis that no experimental work on the sugar cane can be expected to produce the best results, until the planters are in complete control of and pay for the work themselves. And if the plea were put forward that they are too poor and need subventions from the Government, the answer would be that the surest and quickest way to alter this state of things is at once to introduce a levy among themselves, and thus bring science into their routine plantation work.

It would be an interesting subject for a thesis, to make a study of the evolution of scientific work in the sugar industry of these two countries—and indeed of all countries. And Hawaii, with its comparatively recent development, offers a unique and easily accessible example for such an attempt. Such a survey must be made on the spot by one with inside knowledge of affairs ; and there is not the least intention of doing anything of the kind in this article, although this idea suggested itself from a study of the progress of irrigation in the islands. The earlier scientific work in Hawaii consisted of detached excursions in various directions, according to the presence of officers devoted to special branches of research. But, latterly, with the increase in the number of workers, there has been a marked segregation into separate (although often interdependent) sections · pests, diseases, varieties, seedlings, soils, manures, practices, stock, irrigation, forestry, and so on. It has become the custom to appoint committees to deal with some of these subjects each year, and a series of valuable reports have been sent in. A comparison of the relative development in these various sections might serve as a useful form of stock-taking, as to what has been done and what still remains ; or, in other words, what stage of evolution has been reached. Some projects are inevitably dropped before reaching a final stage : we hear little nowadays of the millenium, hoped for in some quarters, from the application of the bud selection in Citrus to the sugar cane : results appear to be slow in materializing. And we wonder whether this method of improving the yields of sugar in the fields is to share the fate of the similar ones, which at one time had a great vogue, namely, selection according to the weight of individual canes or the richness of their juices. There appears to be a process of natural selection going on among the various projects, which have been started from time to time, often with great enthusiasm. Of course sometimes a project is shelved temporarily, through lack of time or money to carry it through, for it is not possible to expand in all directions at once. But, in almost all cases, it is of great importance that the careful observations made and the results obtained. even in, to outward appearance, derelict projects, should be carefully collected and kept in mind. For, with new ideas and methods, many of the data may be found extremely useful at some period; besides which, such projects have a habit of coming to the fore at recurring intervals. An analysis of the projects started at any period is one of the surest signs of the stage of evolution at the time.

Practically all of the aspects of irrigation in Hawaii have been explored to a certain degree : and, from the numberless experiments conducted, many useful data have been accumulated, more or less suitable for statistical treatment. But, now that the ultimate aim of all such work is being reached, namely, a comprehensive economic survey, it is not surprising to detect many faults, in laying down the bases of former experiments and in tabulating the results. The number of factors entering into the question could not be grasped at the start, and are only now becoming more or less completely appreciated, when it is being attemped to investigate the *duty of water* in the cane fields, and to make up averages for Hawaiian conditions. This may well be considered, with our present knowledge, as the final stage in the evolution of irrigation studies; and this is the aspect with which the Committee on Irrigation has concerned itself in their interesting Report which has been lately received. This Committee was a small but strong one, four of the eight members having sent in papers, and others having done so before, all of which are well worth reading. The chairman, JOEL B. COX, in presenting his report, concludes as follows : "Your Committee begs to report that it considers its work to be a fair beginning rather than a great achievement. It has found the subject of the relationship between water applied and the growth of the cane one of great complexity, but one in which the elements are capable of measurement and orderly determination. The sum of work done by all agencies on the problem has enabled a generalized solution to be presented, which will be improved as time goes on and more data are accumulated. It is, however, sufficient to offer tangible quantitative results to those who need them in specific problems connected with the irrigation of sugar cane, and the days of guessing at the value of water should be past for all time."

It would not be possible, within the limits of a single article, to summarize the conclusions arrived at in these five papers : they cover 40 pages of print, and, as is usual with statistical work, are interspersed with numerous diagrams, some of which are of a complicated nature. A great deal of information is compressed into these diagrams, and it requires a certain amount of close application even to understand them : all of which adds to the length of the papers. It will suffice, here, merely to attempt to extract some of the leading ideas contained in the Report of the chairman, which deals with the status of irrigation studies in Hawaii, with special reference to the duty of water.

He commences with a brief reference to former studies, and picks out the work of three writers as most important : W. MAXWELL, who began the scientific study of irrigation in Hawaii in 1906; J. H. FOSS, who first attempted to predict the quantity of irrigation water needed for the production of a given quantity of sugar; and W. P. ALEXANDER, whose general thesis on irrigation in Hawaii was described in this Journal three years ago.[1] At the present time, work of outstanding value is being done by G. F. RENTON, Jr. at Ewa; J. M. WATT, in Kauai; STEWART, at Waimanalo; and J. B. COX at McBryde : this is the work that is summarized in the report. For outside readers interested in irrigation, it is perhaps of special importance to note the great number of factors involved in such a study, for it to produce reliable results.

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[1] *I.S.J.*, 1923, pp. 401-408 and 455-461.

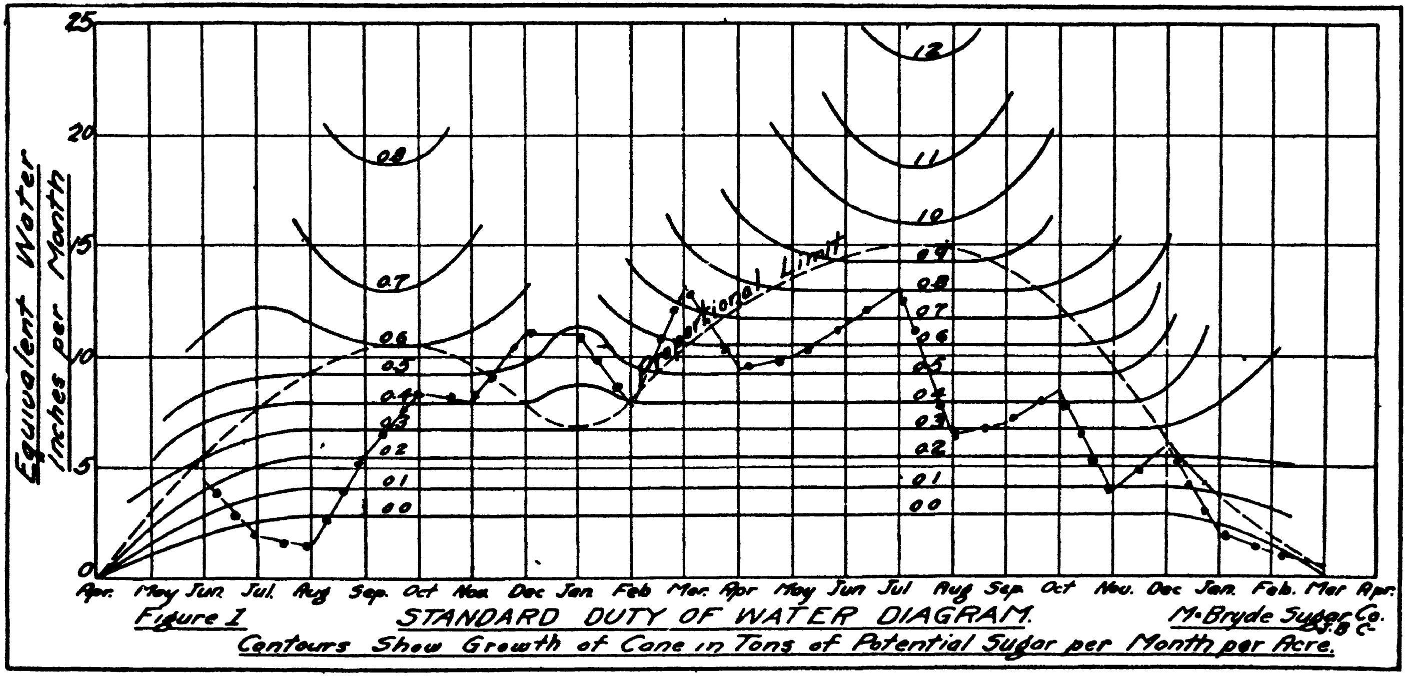
The amount of soil moisture available for the different parts of the root system is the main concern of the cane plant, and numerous estimations have been made of this at varying depths in the soil ; but this study has met with a great many difficulties in the field, and it is generally conceded that more useful results can be obtained by directly measuring the amount of water applied. But the water that the plants received may be in the form of rain, or it may be artificially provided from various sources, either by channel flow or by overhead sprinklers, and it becomes necessary to bring these down to a common basis. Furthermore, irrigation water may be measured at any point between its original source and close to the cane roots, by various methods, and at different intervals of time. We may assume that every estate which uses irrigation is divided up into different levels by contour lines, and that the whole system of water channels is mapped out. For the purpose of the present study, it is considered best to measure the water applied direct to the furrow, between the rows of the cane plants ; and where the measurements have been taken at a different place to convert them to this standard. The unit adopted is " the amount of water applied by careful uniform furrow irrigation, at the rate of four inches per round, or which would cause the same amount of cane growth." Irrigation water, when thus converted, is termed *equivalent water* ; rainfall is generally considered to have an average ratio of equivalence of one to one.

The problem to be solved, in studies of the duty of water for the growth of the sugar cane, is to be able to judge how much water will be needed to produce a given weight of sugar : the latter is judged by the increase in length of cane stalk, and is then termed *potential sugar*. Variables such as the kind of cane grown, the character of the soil, and the amount of manure applied, are within control. Others, such as the age of the cane plants, and the amount of light and heat, may be simply dealt with by recording the date of observation. The date will give the age of the plants, while it is stated that the light and heat are more or less constant in the Hawaiian climate at any place, year by year, during any particular month. And, with these simplifications of the most important factors influencing growth, it is possible to set about the preparation of a graphic record. The one presented extends over the period of two years, April to April, indicates the amount of equivalent water given per pound, and also shows the amount of potential sugar which may be expected to be formed, during any part of the period of growth. It is constructed in the following manner.

A horizontal base line is drawn across the paper, starting from the left hand bottom corner, and this is divided into 24 equal portions, representing months. From each division a vertical line is then drawn to the top of the paper. Starting from the same point, the left hand bottom corner, a vertical line is drawn across the. paper, and this is divided into five portions, each representing five inches of equivalent water. A series of horizontal lines are drawn through these divisions, right across the paper, cutting the month lines at right angles. A diagram is thus obtained which presents a plan, upon which the water applied at each round may be plotted out, throughout the period, up to two years, during which the crop is growing.

There is, obviously, no space on this diagram for plotting the weight of potential sugar obtained by applying a definite amount of water at any

Duty of Water in Hawaii.



This diagram shows how much sugar is likely to be obtained from the application of definite quantities of water at different periods in the growth of the sugar cane, on a red soil area of McBryde Plantation. For use, a tracing is made on transparent paper, to the same scale, of the actual amount of *equivalent water* received in the furrow per round; and, to read off the weight of *potential sugar* expected, the tracing is laid over the diagram. Such a tracing is here printed on the diagram as a dotted line.

period, and a new surface must be found for this. Such is obtained in a direction at right angles to the paper, by imagining a line, starting from the same point as the other two, but coming right out of the paper towards the observer. This line is divided into portions as before, each representing one tenth of a pound of sugar ; and the various amounts obtained by different applications of water at different periods of growth can be indicated by imaginary dots at different elevations above the paper. On assembling the different observations, the results can be recorded by a model, with a flat base and an upper surface varying in height according to the weight of sugar produced. But, by an ingenious adaptation of the well-known contour lines found on the map of every estate, the upper surface of the model can be reduced to one plane ; the model can be collapsed into the plane of the original diagram, where contour lines will show the amount of sugar produced at any point. This arrangement, needless to say, is much more convenient for statistical and other purposes.

The author states that there is strong evidence, amounting almost to certainty, that, up to certain point (termed the *proportional limit*) the growth of the cane is almost directly proportional to the amount of water made available for it. This means that the part of the model, where the amount of water applied is still comparatively low, but increasing, will have as its upper surface an evenly inclined plane ; and that, on the diagram, the contour lines will be equidistant and horizontal. But the proportional limit, which terminates this orderly arrangement, varies in height on the diagram, that is with the amount of water given, according to the age of the plant, and in summer and winter. Therefore the curve of proportional limits, during the growth of the crop, is represented in the diagram by an undulating line, higher in summer and lower in winter, and lower in the first season than in the second.

The diagram was prepared for the red soil areas on the leeward side of McBryde plantation, and the actual equivalent water applied at each round is indicated by dots joined by short lines. Such a diagram, when prepared as the result of several years of careful observation, may serve as a standard for a particular set of fields. It may be used to check the yield each year for each field, and material will thus be accumulated for its gradual perfection. It may then be used as a basis for prophesying the sugar likely to be obtained in any year, and even to form a basis for judging the effect of any change of irrigation policy. Such forecasting, often attempted, will thus rest on a firmer foundation than ever before.

There are other curves which are described by the author, which, however, are illustrated by separate, less complicated diagrams. " As more water is added, more and more plants reach their optimum growth, and begin to be drowned out, until the crest of the curve or point of *maximum growth* occurs . . . This curve should be a round-topped ridge, somewhat above and parallel to the proportional limit curve." Another important curve represents the *economic limit* of watering, namely, the point at which any additional water will not be repaid by the increased sugar obtained : when this point is reached, increase in irrigation should of course cease. Then curves are added as to the effect of fertilizer, the variety of cane, the number of ratoons grown ; and the effects of the type of soil is discussed. Details are not yet available for a consideration of the effect of salinity of water or soil.

The defects in the standard diagram prepared are considered, especially its incompetence to deal with the cumulative effects of prolonged deficiency or surplus supply of water, and the conditions during the ripening period of the cane. A series of suggestions are made as to the best lines of work to be undertaken to perfect the method, which appears to have so much of economic value attached to it; and a concluding section deals with the advisability of standardizing the units and definitions employed by different observers in different places, so that their observations may be more easily utilized by other workers.

C.A.B.

Production of Alcohol from Cellulose.

At the Congress of Chemists recently held in London. interesting contributions to this subject were made, on the one hand by Dr. W. R. ORMANDY, D.Sc., F.I.C., who outlined the Rheinau, Prodor, and the combined Rheinau and Prodor processes,[1] and on the other hand by Sir CHARLES BEDFORD, who gave a particularly optimistic account of the modified Classen process. Sir CHARLES expressed his firm conviction that it was the Classen process that was going to render possible the commercial production of alcohol from sawdust.

THE RHEINAU PROCESS.

Dr. ORMANDY in the course of his paper pointed out that WILLSTATTER in 1913 showed that there was a very great difference in the action of commercial 35-36 per cent. hydrochloric acid in effecting the hydrolysis of cellulose to sugars, as compared with the action of the 39-40 per cent. solution, which discovery formed the basis of the Rheinau process. In 1920 TERRISSE and LEVY, of Geneva, made use of 40 per cent. HCl, but in addition used gaseous hydrochloric acid, which invention is known as the Prodor process.

In the Rheinau process, sawdust is treated with six times its weight of 40 per cent. HCl, the plant required being comparatively simple, viz., a sawdust dryer (to reduce the water content to 0·5 per cent.), a system of transport to a battery of 18 diffusers, an installation for making the hydrochloric acid, and lastly the plant for separating the sugar from the acid and for drying the sugar. The sugar solutions drawn off from the battery contain approximately 28 per cent. of sugar and 26 per cent. HCl, the rest being water. An ingenious system of evaporating the bulk of the hydrochloric acid in a vacuum by bringing the acid sugar solution into contact with a hot inert oil was developed, and the sugar solution discharged from this vacuum evaporating plant contains 56 per cent. of sugar and 9 per cent. of acid. The strong sugar solution is finally evaporated in an apparatus similar to that employed for the production of milk powder, The resulting powder contains approximately: sugar 89 per cent., acid 2 per cent., salt 2 per cent., and water 7 per cent. It is a biscuit-coloured, extraordinarily light and hygroscopic powder dissolving in water to give a dark brown-black solution which requires to be treated or purified according to the purposes to which it is to be put.

THE PRODOR PROCESS.

In this method sawdust dried to 4 per cent. is submitted in a mixer to the action of hydrochloric acid gas, and after 15 mins. it is moistened with 40 per cent. HCl solution. Following this it passes into the digester, the function of which is firstly to ensure the further absorption of HCl, and secondly to complete digestion, i.e., the formation of sugar. On leaving the digester the sawdust is found to have given a 60 per cent. yield, the maximum theoretical being counted as 68 per cent. It enters the dryer-recuperator, which has precisely the opposite function, viz., the separation of the remaining hydrochloric acid. Lastly, the product goes to the diffusion battery, where the sugar is very easily extracted with very few washings by warm water.

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[1] *J. Soc. Chem. Ind.*, 1926, 45, No. 33, 267-273T.

COMBINED RHEINAU AND PRODOR PROCESSES.

Saturation with the gas of the Prodor process and the diffusion battery of the Rheinau process are adopted in the combined processes, which combination allows a great output, and the product is much easier to wash in the diffusers. The digester in this process should be rather called the saturator, the real digestion taking place after transport to the diffusion battery. Usually a 66 per cent. yield is obtained, though 67 per cent. is easily achievable.

THE NEW CLASSEN PROCESS.

Sir CHARLES BEDFORD said the Prodor process of Geneva, and the Rheinau process of Essen, were of considerable interest some years ago before the very marked advance made by that veteran investigator, Dr. CLASSEN, who at the age of over 80 years had produced a process which in a word was revolutionary. Nothing that they had heard indicated that either the Prodor or Rheinau processes or a combination of them were within sight of commercial exploitation. The freeing of the sugars sufficiently from acid to allow of fermentation into alcohol was a grave difficulty, but it was one that CLASSEN had successfully overcome. His new process was entirely different from all others which CLASSEN had patented; the plant used was a vastly simpler installation than anything that had been described by Dr. ORMANDY, and there was an enormous diminution of the time required for the completion of the process. The objects of the catalysts were two-fold; Firstly, they had greatly accelerated the process of conversion of cellulose into sugar; secondly, they had distinctly enhanced the yields. Dr. ORMANDY stated that 60 per cent. or more sugars took six hours for conversion, whereas with the new Classen process it was guaranteed (and he had seen this guarantee fulfilled) to produce between 55 and 60 per cent. sugars in 1½ hours instead of 6 hours. The Classen maximum of sugar produced was 63 per cent.

Later, Sir CHARLES BEDFORD wrote[1] that in Dr. Ormandy's paper no definite statement was made as to whether the resulting sugars were sufficiently free of acid to allow of fermentation into alcohol. Above all (and with due allowance for the necessity for commercial prudence in making such a statement) not even approximate indication of the cost per gallon of concentrated alcohol (e.g., 95 per cent. by volume) produceable by any of these processes was attempted. CLASSEN, on the other hand, guarantees (using catalysts) to produce, and has produced repeatedly before independent experts, between 55 and 60 per cent. sugars in 1½ hours. His maximum production has been 63 per cent. and his minimum time is as low as 50 mins. These results contrast with Dr. Ormandy's figures of like amounts of sugar obtained in six hours instead of 1½ hours. At the present time Dr. CLASSEN and his co-workers are completing their large-scale commercial work in the direction of lowering costs of production, especially as regards acid recovery. It is to be hoped that when these questions have been satisfactorily solved we shall be in possession of a simple and relatively inexpensive method of producing alcohol from cellulose materials, the application of which throughout the world cannot fail to have a very great influence in solving current difficulties as regards the use of alcohol motor fuel, in point of availability and cost.

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[1] Letter published in the *Chemical Trade Journal*, 1926, 137-138.

Determination of Sulphurous Acid in Sugar Factory Products.

By J. P. OGILVIE, F.I.C.

INTRODUCTION.

Sulphur dioxide, or sulphurous acid gas, generated technically by burning roll sulphur in air in suitable ovens, is now quite extensively used in sugar manufacture. Its application was proposed by **PROUST** in 1810, by **DRAPIEZ** in 1811, and by **PERPEN** in 1912, though actually **MELSEN** about the year 1850 induced manufacturers to adopt it as a means of decolorizing in making white sugars without animal charcoal. At the present day it is employed in the sulphitation process of making white sugar, largely practised in Mauritius, Java, Natal, Louisiana, and other countries making "plantation whites." It is also applied in the beet industry when white granulated is the grade produced. Sulphurous acid is valued by the manufacturer on account of its bleaching action, though this is not its only effect on sugar juices. It is known to exert a certain purifying action, even when used without lime, and there seems little doubt that it reduces the viscosity of syrups and other products owing to its modification of the condition of impurities present in the colloid condition.

NEW HEALTH REGULATION.

According to the Public Health (Preservatives, etc., in Food) Regulations,[1] which come into operation on January 1st, 1927, the total free and combined SO_2 in sugars sold in the United Kingdom must not exceed 70 parts per million (or 0·007 per cent.). This impending Regulation has been the subject of not a little discussion among white sugar manufacturers, expecially in regard to the evidence which has led the authorities to specify the very narrow limit of 70 parts per million, when in Canada, for example, one part in 2000 (or 0·05 per cent.) is considered an ample extreme;[2] while in the U.S.A. the value of 350 mgrms. per kg. (of which not more than 70 mgrm. may be in the free state) has been fixed.[3] Seeing, however, that this figure of 70 parts per million will very shortly be the legal limit in this country, it is very much to the interest of importers of white sugars and West Indian yellow crystals, as well as of manufacturers of British beet granulated, to ensure that their wares shall be in compliance with the new regulation. Some notes for manufacturers and chemists on the control of sulphitation in the factory, and especially on the detection and determination of sulphurous acid in sugar products, including sugars, may therefore not be deemed out of place.

SULPHUR OVEN GASES.

Generally speaking the content of the sulphur oven gases in SO_2 is insufficiently controlled, this estimation being often considered unnecessary; yet on the composition of these gases the regularity of sulphitation depends. **REICH**'s method,[4] as modified by **LUNGE**,[5] may safely be adopted for determining with reasonable accuracy and rapidity the amount of sulphur dioxide present in the gases leaving the ovens, and the design of the apparatus required is seen in the accompanying figure. First the aspirator *C* is completely filled with water; then 100 c.c. of water, together with 10 c.c. of N/10 iodine solution, and some starch solution, are introduced into the adsorption bottle *B* after removal of the cork *e*. In order to ascertain that the apparatus is air-tight, clips 1 and 2 are opened, a slow current of air drawn through the apparatus, and then clip 1 suddenly closed. If there is no leakage, no more water will run into the measuring cylinder *D*. In actually carrying out the determination, clip 2 is opened fully, and clip 1 slightly, whereupon the the aspirator works a little, drawing a slow current of sulphur gas through the liquid in *B*, the water running from *C* into *D*, in which it is measured. Gradually the deep blue colour of the liquid in *B* becomes fainter, until at last it suddenly becomes colourless. At this point clips 1 and 2 are closed, and the volume of water in *D* is read off. Now the result, that is the percentage of SO_2 by volume, is readily calculated from the formula : $\frac{100 \times 11{\cdot}14}{v + 11{\cdot}14}$ in which *v* is the volume of water run from the aspirator *C* into the cylinder *D*. Determinations made at fairly frequent intervals with this apparatus ensure maintaining, by suitable regulation of the air supply to the sulphur oven, a SO_2 content at as high and uniform a figure as possible, about 14 per cent. by volume being usually considered the optimum possible in practice, and 8-10 per cent. a good working figure.

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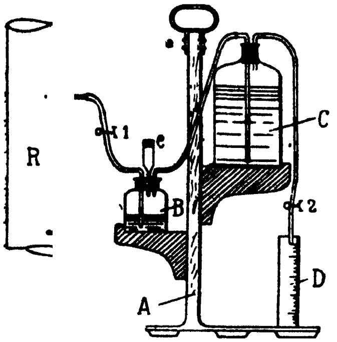
[1] White Paper No 775 of 1925; price 3d., H.M Stationery Office, Kingsway. London, W.C.2. see *I.S.J*, 1925, 157, 216; 1926, 613.

[2] "Regulations under the Food and Drugs Act." Department of Health, Canada. 1924. Page 42.

[3] U S. Food Inspection Decision, No. 76.

[4] *I S.J.*, 1914, 390.

[5] **HEMPEL**'s *Gas Analysis*, Chapter 5.



JUICES AND SYRUPS.

Direct titration with N/10 alkali has been shown by PELLET[1] and others to be quite useless in the cases of both cane and beet juices and syrups, only about half the SO_2 actually present being thus estimated. But direct titration with standard iodine solution, using starch solution as indicator in the well-known manner, has been proved by DE SORNAY,[2] FOUQUET,[3] ZERBAN[4] and others to be adequate for routine work in the cane sulphitation factory. In the case of these products, non-sugars appear to have practically no effect on the iodine, so that previous distillation in the presence of phosphoric acid (as is adopted for wines and certain other products) is unnecessary. But when examining beet factory juices and syrups, as SAILLARD has pointed out,[5] the results of direct iodine titration may be less trustworthy. This may be so also with the products of the cane carbonation factory, and is probably due to the presence of sulphites and sulphides in the carbonated juices, these compounds being derived from the sulphur in the coke used for burning the limestone. Nevertheless, as a rapid routine method this process generally suffices, especially if a titration of the unsulphited carbonated juice be made in order to determine the iodine adsorption.

Details of the volumetric iodine method are as follows : A standard solution of iodine of such a titre that 1 c.c. = 0·001 grm. of SO_2 is prepared, this being done by dissolving 4 grms. of iodine in a solution containing about 8 grms. of potassium iodide in water, the volume being completed to 1000 c.c. In titrating, 25 c.c. of juice, or 10 c.c. of syrup, are pipetted into a porcelain basin, a few drops of starch solution added, and the standard iodine solution run in till a permanent blue colour appears. Alternatively, the titration may be performed in a Vivien tube, or the similar Dujardin graduated device described by PELLET,[1] making the operation more convenient for the untrained assistant.

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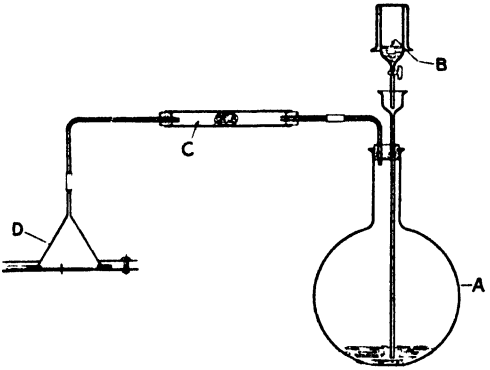
[1] *I.S.J.*, 1911, 48. [2] *I.S.J.*, 1910, 144. [3] *I.S.J.*, 1910, 528. [4] *I.S.J.*, 1911, 278. [5] *I.S.J.*, 1911, 276.

SUGARS, ETC.

Qualitative.—Preliminarily the sample of sugar, etc., should be submitted to this qualitative test: About 25 grms. of it are dissolved in about 100 c.c. of water in a 250 c.c. Erlenmeyer flask, some pure zinc, and a few c.c. of concentrated hydrochloric acid added, and a piece of paper soaked in lead acetate solution placed over the mouth of the flask. In the presence of sulphites, sulphuretted hydrogen is generated, this being detected by a brown or black stain forming on the portion of the filter-paper coming into contact with the gases being evolved. A "blank" test lasting at least 20 mins. should be run before the addition of the solution of sugar, and pure hydrochloric acid and pure zinc (previously washed with dilute acid) only should be used, so that no stain appears during the period stated. A second qualitative test is to dip filter-paper impregnated with potassium iodide and starch into the solution under examination, when in the presence of sulphites, the paper will be turned blue, owing to iodine being liberated. If a positive reaction is obtained by either of these tests, the result should be verified by quantitative examination, using one of the following two methods:



Distillation method: 500 grms. of the sugar dissolved in about 500 c.c. of water are distilled in a suitable apparatus with 5 c.c. of glacial phosphoric acid in a current of washed carbon dioxide, the distillate being received in 50 c.c. of nearly saturated bromine water. When about 150 c.c. have passed over, the operation is stopped, the distillate boiled until the excess of bromine has been eliminated, diluted to about 500 c.c., mixed with 5 c.c. of dilute hydrochloric acid (1:3), and heated to boiling. Then the sulphuric acid is precipitated by the addition of about 10 c.c. of 20 per cent. barium chloride, and boiling continued for about 10 minutes, the precipitated barium sulphate being filtered off, either through a Gooch crucible or a filter-paper, the weight obtained multiplied by 0·27443 and divided by 5, thus giving the percentage of SO_2 present in 100 grms. of the sugar examined.

Sulphide Stain Method: Very sensitive results being yielded by the sulphide stain method described above as a qualitative test, this has been modified to give quantitative results, the stain produced by the sample being compared with a series of standard stains obtained by the addition of known additions of sodium sulphite. Particulars of this very interesting method have been communicated to us by Mr. J. S. MANN, of Messrs. Tate & Lyle, Ltd., to whom for permission to publish these details we express our best thanks. The apparatus used is shown in the figure reproduced herewith, in which *A* is a 400 c.c. flask, provided with a thistle funnel and tap funnel *B*, and a leading tube to which is attached a glass tube *C* holding a small cotton plug, and a funnel *D*, this latter having a clamp for holding the filter-paper impregnated with lead acetate. It is very necessary preliminarily to run a "blank" test to ensure that the zinc and hydrochloric acid used contain no sulphur. About 50 grms. of purest granulated zinc (previously washed with dilute acid to remove the traces of sulphur that are always present) are placed in the flask *A*, and just covered with distilled water. The tap funnel is fully charged with 50 c.c. of pure dilute hydrochloric acid (1 : 2 of water), which is allowed to run slowly through the thistle funnel over the zinc, the gases evolved being passed through the lead-impregnated filter-paper for 30 minutes. The latter is prepared by soaking English filter-paper in a 25 per cent. solution of neutral lead acetate and drying in air, the circles cut to size being kept moist ready for use in desiccators in which the usual dehydrating agent has been replaced by wet pumice.

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[1] *Ibid*

No discoloration of the paper having resulted after the time stated, or but a very faint stain, a series of standard stains are prepared. Exactly 0·06 grm. of pure anhydrous sodium sulphite are dissolved in a sugar liquor made from 300 grms. of triple washed granulated sugar (free from SO_2 and other reducing agents), taken up in 300 c.c. of boiled distilled water. Theoretically this solution should contain 0·00985 per cent. of SO_2, but as a small amount of oxidation takes place during manipulation, the exact titre is determined by the addition of standard iodine to 162 c.c. of the solution (100 grms. of solids), and titration in the usual manner with thiosulphate, using starch indicator. Convenient solutions for the preparation of the series of standard stains are made by diluting this strong solution, *A*, with a 60° Brix sugar liquor, *B* (made from the aforementioned triple washed sugar), in the following proportions :

	Solution *A*.	Solution *B*.
1	12·5 c.c.	35·5 c.c.
2	10·0 c.c.	38·0 c.c.
3	7·5 c.c.	40·5 c.c.
4	5·0 c.c.	43·0 c.c.

Then, 8·1 c.c. of the mixed solutions, taken in the order above, give respectively standard stains equivalent to : 0·0025, 0·0020, 0·0015 and 0·0010 per cent. of SO_2 when 5 grms. (solids) is used for the test.

In assaying the sample under consideration, 5 grms. (or its equivalent in the case of a liquid) are dissolved in distilled water, and transferred to the flask through the tap and thistle funnel, this being followed by another 50 c.c. of dilute hydrochloric acid, the test being of course run for 30 minutes, all other conditions being exactly as in the preparation of the standard series of stains. The stain so obtained is compared with the standards, and the percentage of SO_2 present is estimated accordingly. Should the stains be found lighter than the 0·0010 member of the series, or darker than the 0 0025, the test must be repeated on a larger or smaller amount of the sample.

The Root Disease Complex of Sugar Cane.[1]

By H. P. AGEE.

The specialists of the Hawaiian Experiment Station are now devoting a great deal of attention to the problem that was originally termed "Lahaina disease," and has since been designated "root rot" or "growth failure," and is now, with added knowledge of the number of interrelated factors involved, coming to be known as the "growth failure complex," or, as these paragraphs have been headed, the "root disease complex of sugar cane."

Without attempting to give a great deal of detail of a historical nature, it should be pointed out that the Lahaina variety of sugar cane, originally brought to the islands in 1854 by Captain Pardon Edwards, in the ship "George Washington," and landed at Lahaina, Maui, and at one time a mainstay of the industry, began about 1897 to 1898 to show signs of distress on the island of Hawaii. Mr. JOHN T. MOIR has contributed an interesting account of the decline of this cane in the Hilo district, and its substitution by Rose Bamboo and afterwards by Yellow Caledonia. About 1910, or shortly prior thereto, the Lahaina variety began to fail on Oahu, and a few years later the situation became serious on some of the best of the irrigated lands of Kauai and Maui, as well as Oahu. Fortunately, an industrial calamity was averted by the substitution of H 109, preceded by a temporary substituting of D 1135 and Yellow Caledonia on some fields.

Previously this same cane, Lahaina, under the names of Bourbon and Otaheite, had given way to hardier varieties in various parts of the world, including the West Indies and Java. Many thought (and some perhaps still feel) that this trouble was due to a deterioration of the variety itself, but evidence accumulates showing that we are dealing with a soil problem, both chemical and biological in nature. The Lahaina variety, under the name of Florida Green, grows luxuriantly to-day on the muck lands that fringe Lake Okechobee, where it is prized for syrup making. Here in Hawaii it still does well on new lands on Maui, and Mr. FAYE at Kekaha contends that on many of his old fields this cane does as well as it ever did. Seed cane from such good areas has failed to give good results when planted on fields that showed distress.

Furthermore, we have, as a sidelight on this point, the interesting evidence that Lahaina cane (under another name) was showing signs of weakness on certain soils of the West Indies nearly eighty years ago, in fact six years before Captain Edwards brought it to Maui in 1854. From an old work, "The Sugar Planters' Manual," by W. J. EVANS, M.D., published in Philadelphia in 1848, we read :—

> "The sugar cane has never been produced from seed in the West Indies, it is propagated by cuttings or germs; plants so raised, as is well known, become in time liable to deterioration and disease, and often entirely disappear.
>
> "There is, indeed, much reason for believing that this change has already commenced in the Bourbon and Otaheite cane. Ought we not to enquire whether this disposition might not be checked, or whether a great improvement in the vigour of these plants might not be effected, by a change of cuttings between colony and colony, or even between plantations in the same colony?"

Thus we see we are not dealing with a new or a local problem, but one which goes back to the early days of sugar cane cultivation, and extends to most of the regions where cane has been grown.

In Hawaii, with the cause of the trouble still in doubt, relief came through the gradual substitution of Yellow Caledonia, D 1135, and H 109 for Lahaina. It was in 1921 and shortly thereafter, when, in the hardier varieties, here and there, symptoms were noticed akin to those in Lahaina as it began to go, that interest in the question quickened, and the Experiment Station was called upon to increase its efforts to solve the mystery back of the whole issue.

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[1] An Introductory Paper read at the annual meeting of the Hawaiian Sugar Technologists' Association, October, 1926.

The investigation, as we interpret it, fittingly begins with the question : What caused the Lahaina variety to fail, first on Hawaii, afterwards on the other islands ? This enquiry paves a way toward information on other questions of immediate and future importance to the Hawaiian industry, to wit : Is the resistance of such varieties as Yellow Caledonia, D 1135, and H 109 to the injurious factors that affected Lahaina cane merely a relative one ? Are these factors influencing the hardier canes in an appreciable degree and retarding yields to a point under what we might attain if the damaging influences were controlled ? Have the injurious factors reached their height, or is their potentiality for harm gradually augmenting (cloaked, perhaps, by better agricultural procedures) toward a point where the hardier varieties will acutely feel their influence ? Will Yellow Caledonia, D 1135, and H 109 have some day to give place to still hardier types of cane, and if so, what eventually will be the fate of the sturdier varieties ? Can these adverse soil factors be contended with in other ways than by resistant varieties ?

In short, the success of our plantations seems dependent upon a continuous one-crop agriculture ; what must we do to count upon continuing it twenty-five, fifty, a hundred years longer ? Thus far we have had steady increases in yield per acre. What are the soil factors that may interfere with holding the yields we now have and making still better ones and how shall we deal with them ?

The work as now organized to give information on these questions has several branches in the different departments of the Experiment Station, all of them in close co-operation. The various contributions on this subject made to the Hawaiian Sugar Technologists' 1926 meeting show the ramifications of the problems. They set forth what we now know about a number of well-identified agencies in our soil. that either retard cane root development or actually destroy healthy root tissue after it is formed.

Mr. Muir shows us that numerous species of nematodes feed upon sugar cane roots. He lays special emphasis on two species, and counts them as important factors of our problem. Mr. Van Zwaluwenburg has described the rôle of several minute soil animals, other than nematodes, that feed upon cane roots, but on the whole he considers them of minor rather than major significance. Mr. Lee and his associates confirm the findings of C. W. Carpenter, that a pythium-like fungus is an active agent in the destruction of sugar cane roots. Through the histological work of Mr. Weller, it is shown that the cortex rots are relatively unimportant as compared with stele rot, except when the cortex rots occur on the root tip. Mr. McGeorge treats first of the saline accumulations on irrigated plantations. These, often toxic to Lahaina cane, are resisted by stronger varieties. He then discusses aluminium salts in acid soils and their injurious effect upon cane roots. If these adverse agencies operating singly do harm to cane roots, their capacity to do real damage must be far greater when two or more of them act in combination against the root tissue of the plant. The potency of toxic salts or the severity of attack by organisms may well be expected to be more intense after years of one-crop agriculture than in new lands. (However, it must be noted that we have seen on virgin soil some definite cases of Lahaina disease in the past). It is probable that some of these deleterious factors are on the increase. Their potentialities for harm are no doubt offset in part by better agriculture. The degree to which the situation, industrially speaking, may become more aggravated, is, as has been pointed out, a prime consideration of the investigation.

If still hardier types of cane are to be required, we must have them on hand and know their commercial possibilities in advance of the time when the demand for them is upon us. Work toward this end is well advanced. We now have combinations of our standard canes with the hardy Uba or Chinese type. Hybrids, quarter-breeds, eighth-breeds have already been secured. Some of these present interesting pedigrees, combining in one such varieties as Uba, Badila, D 1135 and H 109. Canes of this sort are now undergoing the routine of preliminary testing, and the promise some of them offer is distinctly encouraging.

The breeding cane Kassoer, that has contributed so much to the development of strong varieties in Java, is now here and is about to be released from quarantine. Some of the progeny of this cane that are doing so well in Java have also been imported, and no doubt we can expect much of them from the standpoint of root rot resistance. The root disease situation in Java is unquestionably much worse than it is with us. Resistant Java canes therefore have special interest.

SOME HISTORICAL NOTES ON LAHAINA CANE.[1]

Lahaina (also known as Otaheite, Bourbon, Louzier) is one of the celebrated sugar cane varieties of the world.

It originated in Otaheite, or neighbouring islands, of the South Pacific.

In 1766-1768, Bougainville, sailing around the world, took this cane from Otaheite to Mauritius and Bourbon.

Through the influence of the French Government this, among other canes, was taken to their West Indian colonies before 1793.

In 1793 the cane was brought to Antigua, British West Indies, from neighbouring French islands.

In 1791, Captain BLIGH, on a second voyage to the South Pacific to bring breadfruit to the British West Indies, took this variety of sugar cane to Jamaica.

In 1854, Captain PARDON EDWARDS, in the ship George Washington, landed the variety at Lahaina, Maui, from the South Pacific.

In 1913 this variety occupied 80,000 acres in the Hawaiian Islands, mostly on the best irrigated lands.

Lahaina is a variety that flourishes under prime conditions, but is sensitive to adverse ones. While it has been an important factor in the development of the sugar industry, it has also figured conspicuously in many of the historic disease epidemics in various parts of the sugar cane world. Thus :—

1848-51, in Mauritius and Réunion (Bourbon) the cane was affected by a disease characterized by a " corkscrewing " of the top and a yellowing off. Symptoms were observed 15 years before the fulminant outbreak.

1857-65, in Brazil, in an epidemic of gumming, Lahaina was the variety mainly affected. Gumming was also responsible for an epidemic in Madeira in 1885, and again appeared in drastic form in Mauritius in the nineties.

1872, in Porto Rico, an epidemic characterized by a top-rot as a dominant symptom caused the elimination of the cane there.

1890, or thereabouts, the variety succumbed in the British West Indies. Symptoms of weakness had been noticed as early as 1848.[2]

1896-98, on the island of Hawaii, the cane began to succumb and was replaced by Rose Bamboo and Yellow Caledonia.

1910, and subsequently, the Lahaina cane failed on the irrigated plantations of Oahu, Kauai and Maui.

1926, the variety still flourishes in Florida, and in a few fields on Maui and Kauai; but it has disappeared from commercial cultivation in nearly all other parts of the world.[3]

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[1] Taken largely from *Cane Sugar*, by NOEL DEERR. [2] EVANS' *Sugar Planters' Manual*.

[3] Editor's Note.—Peru appears to be one of the outstanding exceptions : *c.f.* ROSENFELD'S article in our last issue, p. 593 and Plate III.

Drawbacks in using Empire Sugar.

Representations to the Chancellor of the Exchequer.

The West India Committee, the British Empire Producers' Organization, the British Sugar Refiners' Association, the Manufacturing Confectioners' Alliance and the British Sugar Beet Society have just lately drawn up a joint letter addressed to the Chancellor of the Exchequer in which they draw his attention anew to certain disadvantages to which sugar produced within the Empire overseas and in Great Britain is at present subject in this country, owing to existing arrangements in connexion with drawbacks on goods exported containing sugar. We give below the principal points of the letter.

" In a letter dated August 18th, 1925. and addressed to The Chairman of the Board of Customs and Excise, the West India Committee pointed out that manufacturers in this country with an export trade in sugar products were in practice precluded from buying Empire sugar. They further pointed out that it had been represented to them by the sugar refiners that, under the existing drawback arrangements, they were compelled to supply to every such manufacturer sugar of entirely foreign origin so that he could obtain the drawback at the full rate of duty, adding that while the proportion of Empire sugar coming to this country was relatively small this system was practicable, but that with the proportion of Empire sugar increasing it had become difficult, if not impossible.

" The result of the disabilities above referred to is that manufacturers of sugar goods having an export trade are debarred from using Empire sugar, since, even if they only purchase small quantities, their drawback value on exportation is depressed by the quantity of Empire sugar delivered into their factories during any stated period, irrespective of whether any of this Empire sugar has been used in the exported goods or not. For example, at the present time, if during a period of twelve months a manufacturer takes delivery of sugar into his factory consisting of 25 per cent. Empire and 75 per cent. non-Empire, his drawback value for the following twelve months will then be : 25 per cent. at 7s. 4½d. plus 75 per cent. at 11s. 8d. = 10s. 7d. per cwt. or a substantial reduction on the full rate of 11s. 8d. per cwt. In this connexion we append, as a concrete example of the disadvantages to which Empire sugar is subject, an extract from a letter written by one of the large manufacturers in this country to a wholesale dealer through whom he buys his sugar. The effect of the present state of affairs is that the refiners are compelled to restrict and at times to suspend altogether their purchases of Empire sugar.

" We understand the object of H.M. Government in extending to Empire sugar a preference in the Customs and Excise duties was to secure the development of the sugar industry within the Empire and to encourage the importation of Empire sugar into this country in order incidentally that the purchase price of sugar might be paid to British producers instead of to foreigners and we cannot believe that you, Sir, could view with satisfaction the continuance of a system which is admittedly compelling sugar users to discriminate against Empire sugar in favour of the foreign product.

" In the circumstances we beg to request that such steps as may be necessary may be taken as will permit of the drawback on all sugar goods exported from this country being granted at the full rate of duty, provided that in a given period each manufacturer has received such amount of non-Empire sugar as would be required to manufacture the quantity of sugar goods which he has exported. To carry out this proposal, we suggest that quarterly periods could be taken to form the basis of calculation. At the end of every three months the return of the deliveries of sugar into the manufacturers' warehouse could be made to H.M. Board of Customs, and if during that period the sugar used in the goods exported by such manufacturer—as entered and vouched for in the Drawback Claim—was less than the quantity of non-Empire sugar taken into his factory during the period, then on such sugar he should receive drawback at the full rate of 11s. 8d. per cwt.

"In conclusion we desire to state that it is the considered opinion of every section of the Empire sugar industry that the adoption of the proposals outlined in this letter would undoubtedly simplify the procedure for dealing with drawbacks and would, moreover, be consonant with the declared policy of the Government in respect of Imperial Preference."

The following is the extract from a letter written by one of the large jam manufacturers to a wholesale dealer through whom he buys his sugar. "I find that Tate & Lyle had not sufficient non-Empire (sugar) at Brentford Docks to execute one of our recent orders, and sent us some Empire sugar. A Customs Official has pointed out to us that this will reduce our rate of drawback on all the jams we export and supply to ships' stores for twelve months. I shall therefore be glad if you will tell Tate & Lyle in future never to send us Empire sugar if they happen to be short of non-Empire."

Bagasse as Fuel.

By R. F. HUTCHESON, A.M.I. Mech. E.

Bagasse consists of fibre, sugar, glucose (reducing sugars), undetermined solids and water. As the percentage of glucose is small and the calorific value (6750 B.T.U.) is almost the same as sugar, it may be taken as such to facilitate calculations. Undetermined solids which amount to about 1 per cent. can be ignored. Therefore a bagasse consisting of 47 per cent. fibre, 3·5 per cent. sugar, 0·5 per cent. glucose, 1 per cent. undetermined solids and 48 per cent. water, can be taken as 47 per cent. fibre, 4 per cent. sugar and 48 per cent. water.

Calorific Value per lb. of Bagasse.

The Dulong formula states: B.T.U. per lb. $= 14{,}500\,C + 62{,}000\,(H - \frac{O}{8})$, where the oxygen is taken as being in combination with the hydrogen, as water is of no use for bagasse. The nearest formula that the writer can find to agree with calorimeter tests is that quoted by P. H. Parr, where the oxygen is taken as in combination with the carbon as carbon dioxide and gives the following formula: B.T.U. per lb. $= 62{,}000\,H + 14{,}500\,(C - \frac{3}{8}\,O)$.

First find the calorific value of each: In sugar, $C_{12}\,H_{22}\,O_{11}$, there is 42·1 per cent. C, 6·4 per cent. H, and 51·5 per cent. O. Therefore B.T.U. per lb. $— 62{,}000 \times 0{\cdot}064 + 14{,}500\,(0{\cdot}421 — 0{\cdot}375 \times 0{\cdot}515) = 7274$.

The composition of fibre is slightly variable and different canes have different compositions, but a good average is as follows: 47·0 per cent. C, 6·5 per cent. H and 46·5 per cent. O. Therefore B.T.U. per lb. $= 62{,}000 \times 0{\cdot}065 + 14{,}500\,(0{\cdot}47 - 0{\cdot}375 \times 0{\cdot}465) = 8322$.

The calorific value of bagasse is therefore : B.T.U. per lb. = 8322 × per cent. fibre + 7274 × per cent. sugar. Taking as an example bagasse consisting of 47 per cent. fibre, 4 per cent. sugar and 48 per cent. water, B.T.U. per lb. = 8322 × 0·47 + 7274 × 0·04 = 3911 + 291 = 4202.

PRINSEN GEERLIGS gives the following formula : B.T.U. per lb. = 8550 × per cent. fibre + 7119 × per cent. sugar + 6750 × per cent. glucose. Taking the same example as above, B.T.U. per lb. = 8550 × 0·47 + 7119 × 0·035 + 6750 × 0·005 = 4018 + 249 + 33 = 4300.

From this value, however, must be taken the heat required to evaporate the water in the bagasse, to get which the flue gas temperature and the temperature of the bagasse must be known. Let T_1 = flue gas temperature, and T_2 = bagasse temperature. The heat to evaporate moisture is as follows : $(212 - T_2) + 966 + (T_1 - 212) \times 0{\cdot}48$, 0·48 being the specific heat of steam.

Taking the flue gas temperature as 500° F. and the bagasse temperature as 80° F. (212 — 80) + 966 + (500—212) × 0·48 = 1236. 0·48 × 1326 = 593 B.T.U. and 4202 — 593 = 3609 B.T.U. per lb. of bagasse.

HEAT REQUIRED TO PRODUCE COMBUSTION.

On combustion each lb. of carbon combines with 2·67 lbs. of oxygen, and gives 3·67 lbs. of carbon dioxide, while each lb. of hydrogen gives 9 lbs. of water ; 12 lbs. of air contain 2·67 lbs. of oxygen. The results of combustion are :—

FIBRE.		LBS.	SUGAR.		LBS.
CO_2 = 0·47 × 3·67	=	1·725	0·421 × 3·67	=	1·545
H_2O = 0·065 × 9	=	0·585	0·064 × 9	=	0·576
N = 0·47 × (12 — 2·67)	=	4·39	0·421 × (12 — 2·67)	=	3·93
		6·70			6·051

Using 100 per cent. excess air :—

FIBRE		LBS	SUGAR		LBS.
CO_2 =	=	1·725		=	1·545
H_2O =	=	0·585		=	0·576
N = 4·39 × 2	=	8·78	3·93 × 2	=	7·86
O = 0·47 × 2·67	=	1·253	0·421 × 2·67	=	1·123
		12·343			11·104

The heat available for generating steam is the difference between the calorific value of the fuel *plus* the initial heat of the air and fuel above 32° F., and the heat contained in the waste gases. The heat contents of the gases are as follows : The specific heat of CO_2 = 0·216 ; O = 0·218 ; N = 0·244 ; and H_2O = 0·48. Taking the flue gases at 500° F. and the normal temperature at 80° F. there is a difference of 420° F.

CO_2 = 420 × 0·216 = 90·7 B.T.U.
O = 420 × 0·218 = 91·5 B.T.U.
N = 420 × 0·244 = 102·4 B.T.U.
H_2O = (212 — 80) + 966 + (500 — 212) × 0·48 = 1236 B.T.U.

Therefore the heat contents of the gases from 1 lb. of fibre will be :—

CO_2 = 1·725 × 90·7	=	156
O = 1·253 × 91.5	=	114
N = 8·78 × 102·4	=	899
H_2O = 0·585 × 1236	=	735
		1904 B.T.U.

The heat contents of the gases from 1 lb. of sugar will be :—

CO_2 = 1·545 × 90·7 = 140
O = 1.123 × 91·5 = 103
N = 7·86 × 102·4 = 805
H_2O = 0·576 × 1236 = 712

1760 B.T.U.

Taking into account the moisture introduced with the air, and supposing the air to contain 1 per cent. moisture, then under the heading of "Air required to burn 1 lb. bagasse," it is shown that 1 lb. of fibre requires 5·64 lbs of air and 1 lb. of sugar 5·05 lbs. of air. Therefore : H_2O for 1 lb. fibre = 5·64 × 0·01 = 0·0564 lbs. ; 0·0564 × 1236 = 69 B.T.U. ; and with 100 per cent. excess air = 138 B.T.U. ; 1904 + 138 = 2042 B.T.U.

H_2O for 1 lb. sugar = 5·05 × 0·01 = 0.0505 lbs. ; 0·0505 × 1236 = 62 B.T.U. ; which with 100 per cent. excess air = 124 B.T.U. ; 1760 + 124 = 1880 B.T.U.

The heat available for generating steam from 1 lb. of fibre is therefore : 8322—2042 = 6280 B.T.U. ; deduct 3 per cent. for ash = 6091 B.T.U. ; and deduct 5 per cent. for radiation = 5786 B.T.U. Hence, the actual heat absorbed by the water in the boiler for 1 lb. of fibre is : 5786 B.T.U.

The heat available for generating steam from 1 lb. of sugar is : 7274 — 1880 = 5394 B.T.U. ; deduct 1 per cent. for ash = 5340 B.T.U. ; and deduct 5 per cent. for radiation = 5073 B.T.U. The actual heat absorbed by the water in boiler from 1 lb. of sugar is : 5073 B.T.U.

With gases at 500° F., and initial temperature at 80° F., the net calorific value of the bagasse is :—

B.T.U. 1 lb. = 5786 × per cent. fibre + 5073 × per cent. sugar — 1236 × per cent. moisture
= 5786 × 0·47 + 5073 × 0·04 — 1236 × 0·48
= 2719 + 203 — 593
= 2329 B.T.U. per lb. Giving a fuel efficiency of 64·5 per cent.

Taking the feed water at 200° F. and the boiler pressure at 100 lbs. per sq. in. each lb. of water requires : 1185 — (200 — 32) = 1017 B.T.U.

Therefore 1 lb. of bagasse will evaporate : $\frac{2329}{1017}$ = 2·29 lbs. of water.

Should only 50 per cent. excess air be used, the calorific value of the bagasse using the above calculations will be : 2652 B.T.U. per lb., giving a fuel efficiency of 73 per cent. and 1 lb. of bagasse will evaporate 2·6 lbs. of water.

The heat transmission of a fire-tube boiler is about 5 B.T.U. per sq. ft. of H.S. per hour per 1° F. mean temperature difference. To find the mean temperature difference between the flue gases and the water in the boiler : Let A = the initial temperature ; B = the final temperature ; C = the mean temperature.

$$\text{Therefore } C = \frac{A - B}{\log_e \frac{A}{B}}$$

Water in boiler = 338° F., flue gas temperature = 500° F., and furnace temperature = 1800° F. Therefore A = 1800 — 338 = 1462° F. ; B = 500 — 338 = 162° F. ; and C = 590° F.

The heat transmission for a fire tube boiler is : 590 × 5 = 2950 B.T.U. Therefore the evaporation per sq. ft. H.S. per hour is : 2950 ÷ 1017 = 2·9 lbs.

AIR TO BURN 1 LB. OF BAGASSE.

The weight of atmospheric air required to support combustion in a furnace varies with the amount of the constituent hydrogen and carbon of the fuel. Each lb. of carbon requires 2·667 lbs. of oxygen, a quantity supplied by 12 lbs. of air. Each lb. of hydrogen requires 8 lbs. of oxygen, a quantity supplied by 36 lbs. of air. The weight of air in lbs. theoretically required for the combustion of any kind of fuel may be found by the following formula : W in lbs. $= (12 \times \text{per cent. } C) + (36 \times \text{per cent. } H - \frac{O}{8})$.

In calculating the air required for bagasse, only the carbon need be taken into account, as the combustible elements in bagasse contain hydrogen and oxygen in the same proportion that they exist in water. Air required to burn 1 lb. fibre containing 47 per cent. carbon $= 0{\cdot}47 \times 12 — 5{\cdot}64$ lbs. Air required to burn 1 lb. sugar containing 42·1 per cent. carbon $= 42{\cdot}1 \times 12 = 5{\cdot}05$ lbs.

Bagasse containing 47 per cent. fibre and 4 per cent. sugar will require : $0{\cdot}47 \times 564 + 0{\cdot}04 \times 5{\cdot}05 = 2{\cdot}9$ lbs. of air per lb. of bagasse ; 100 per cent. excess air is considered to give satisfactory results.

Volume of air supplied to furnace using 100 per cent. excess : $2{\cdot}9 \times 2 = 5{\cdot}8$ lbs. of air per lb. of bagasse. Temperature of air 80° F. Volume in cub. ft. of 1 lb. of air at 32° F. = 12·4 cub. ft.

Volume at 80° F. $= \dfrac{80 + 460}{32 + 460} \times 12{\cdot}4 = 13{\cdot}6$ cub. ft.; $13{\cdot}6 \times 5{\cdot}8 = 78{\cdot}88$ cub. ft. of air required per lb. of bagasse.

To find the volume of the gases from 1 lb. of bagasse : The composition of the bagasse is 23·7 per cent. C, 3·2 per cent. H, 24 per cent. O and 48 per cent. H_2O. The results of combustion using 100 per cent. excess are :—

$$\begin{array}{rlcl}
CO_2 = & 0{\cdot}237 \times 3{\cdot}67 & = & 0{\cdot}87 \\
H_2O = & 0{\cdot}032 \times 9 & = & 0{\cdot}288 \\
N = & 0{\cdot}237 \times 9{\cdot}33 \times 2 & = & 4{\cdot}4 \\
O = & 0{\cdot}237 \times 2{\cdot}67 & = & 0{\cdot}63 \\
H_2O = & \text{evaporated from the bagasse} & = & 0{\cdot}48 \\
H_2O = & \text{introduced with air } 5{\cdot}8\ \ 0{\cdot}01 & = & 0{\cdot}058 \\
\hline
 & & & 6{\cdot}726
\end{array}$$

$$\begin{array}{rllcl}
 & \text{Lbs} & \text{Cub ft/Lb} & & \\
CO_2 = & 0{\cdot}87 & \times\ 8{\cdot}1 & = & 7{\cdot}0 \text{ cub. ft. at } 32^\circ \text{ F.} \\
H_2O = & 0{\cdot}826 & \times\ 20 & = & 15{\cdot}52\ \ ,,\ \ ,,\ \ ,, \\
N = & 4{\cdot}4 & \times\ 12{\cdot}8 & = & 56{\cdot}3\ \ ,,\ \ ,,\ \ ,, \\
O = & 0{\cdot}63 & \times\ 11{\cdot}2 & = & 7{\cdot}0\ \ ,,\ \ ,,\ \ ,, \\
 & & & & 86{\cdot}8\ \ ,,\ \ ,,\ \ ,,
\end{array}$$

With the flue gas temperature at 500° F., the volumes will be :—

$$\begin{array}{rlcl}
CO_2 = & 7{\cdot}0 \times \dfrac{500 + 460}{32 + 460} & = & 13{\cdot}65 \text{ cub. ft.} \\
H_2O = & 16{\cdot}52 \times \dfrac{500 + 460}{32 + 460} & = & 32{\cdot}0\ \ ,, \\
N = & 56{\cdot}3 \times \dfrac{500 + 460}{32 + 460} & = & 109{\cdot}7\ \ ,, \\
O = & 7{\cdot}0 \times \dfrac{500 + 460}{32 + 460} & = & 13{\cdot}65\ \ ,, \\
\hline
 & & & 169{\cdot}00\ \ ,,
\end{array}$$

That is, the volume of flue gases from 1 lb. of bagasse using 100 per cent. excess air = 169 cub. ft.

Should the analysis of the flue gases be known, then the air used per lb. of bagasse and the heat utilized in producing combustion can be got as follows : As an example take a flue gas with the following analysis : CO_2 = 15 per cent., CO = 1 per cent., O = 5 per cent. and N = 79 per cent., the excess air being 31 per cent. One lb. of carbon combines with 2·66 lbs. of oxygen, and forms 3·66 lbs. of carbon dioxide, therefore 1 lb. of carbon dioxide contains : $\frac{2{\cdot}66}{3{\cdot}66} = 0{\cdot}727$ lbs. of oxygen · and $1 - 0{\cdot}727 = 0{\cdot}273$ lbs. of carbon. Again 1 lb. of carbon combines with 1·33 lbs. of oxygen and forms 2·33 lbs. of carbonic oxide. Therefore 1 lb. of carbonic oxide contains : $\frac{1{\cdot}33}{2{\cdot}33} = 0{\cdot}571$ lbs. of oxygen · and $1 - 0{\cdot}571 = 0{\cdot}429$ lbs. of carbon.

The weight of each of the gases at 32° F. is as follows :—

CO_2 = 0·122 lbs. per cub. ft.
CO = 0·078 ,, ,,
O = 0·089 ,, ,,
N = 0·078 ,, ,,

Therefore $CO_2 = 15 \times 0{\cdot}122 = 1{\cdot}83$ lbs. per 100 cub. ft.
$CO = 1 \times 0{\cdot}078 = 0{\cdot}078$,, ,, ,,
$O = 5 \times 0{\cdot}089 = 0{\cdot}445$,, ,, ,,
$N = 79 \times 0{\cdot}078 = 0{\cdot}162$,, ,, ,,

In 1·83 lbs. of CO_2 there are $1{\cdot}83 \times 0{\cdot}273 = 0{\cdot}499$ lbs. of carbon. Again in 0·078 lbs. CO there are $0{\cdot}078 \times 0{\cdot}429 = 0{\cdot}033$ lbs. of carbon, giving a total of 0·532 lbs. of carbon in 100 cub. ft. of flue gas.

For every 0·532 lbs. of carbon there are 0·162 lbs. nitrogen ; therefore 1 lb. of carbon = 11·58 lbs. of nitrogen. Air contains 77 per cent. nitrogen ; therefore the air required to give 11·58 lbs. of nitrogen is 15 lbs. That is to say, each lb. of carbon in the fuel requires 15 lbs. of air taking the same bagasse as in the previous example consisting of 47 per cent. fibre, 4 per cent. sugar and 48 per cent. moisture.

The contents per lb. are : 23·7 per cent. C, 3·2 per cent. H, 24 per cent. O and 48 per cent. H_2O, the 1 per cent. undetermined solids not being included. In 1 lb. of bagasse there is 0·237 lbs. of carbon. Therefore $0{\cdot}237 \times 15 = 3{\cdot}55$ lbs. of air ; the volume of air being 13·6 cub. ft. × 3·55 lbs. = 48 cub. ft. of air at 80° F. per lb. of bagasse.

HEAT REQUIRED TO PRODUCE COMBUSTION.

Taking the flue gas temperature at 500° F., and the air at 80° F., gives a temperature difference of 420° F. First finding the volume of the flue gases, from previous calculations it was shown that the amount of carbon in the gases $CO_2 + CO$ was 0·532 lbs., made up of 0·499 lbs. from the CO_2 and 0·033 lbs. from the CO. That is, $\frac{499}{532} = 0{\cdot}938$ lbs. produce CO_2 ; and 0·062 lbs. produce CO.

In each 1 lb. of bagasse there is 0·237 lbs. of carbon, deduct 3 per cent. as going to ash, leaving 0·230 lbs. C per lb. of bagasse. Therefore, 0·230 lbs. of C produces $0{\cdot}23 \times 0\ 938 = 0{\cdot}216$ lbs. of CO_2 ; and $0{\cdot}23 \times 0{\cdot}062 = 0{\cdot}0142$ lbs. of CO ; 0·499 lbs. carbon produce 15 cub. ft. of CO_2. Therefore, 0·216 lbs. would produce : $\frac{15 \times 216}{499} = 6{\cdot}5$ cub. ft. CO_2.

Similarly, 0·033 lbs. carbon produce 1 cub. ft. CO. Therefore, 0·014 lbs. would produce $\frac{1 \times 14}{33} = 0{\cdot}424$ cub. ft. CO.

The volume of oxygen is : $\frac{6{\cdot}5 \times 5}{15} = 2{\cdot}16$ cub. ft. : that of nitrogen is : $\frac{6{\cdot}5 \times 79}{15} = 34{\cdot}2$ cub. ft. N.

Giving a total volume of :—

CO_2 = 6·5
CO = 0·424
O = 2·16
N = 34·2

43·284 cub. ft. at normal temperature and pressure.

The heat carried off by each gas is :—

		Vol. of Gas		Wt per Cub ft.		Temp Diff.		Spec Heat.		B.T U.
CO_2	=	6·5	×	0·122	×	420	×	0·216	=	71·9
CO	=	0·424	×	0·078	×	420	×	0·246	=	3·4
O	=	2·16	×	0·89	×	420	×	0·217	=	17·5
N	=	34·2	×	0·78	×	420	×	0·244	=	273·3
										366·1

Each lb. of hydrogen gives 9 lbs. of water. Therefore, 0·032 × 9 = 0·288 lbs. of water per lb. of bagasse.

Taking moisture introduced by air as 1 per cent., therefore 3·55 × 0·01 = 0·0355 lbs. ; 0·288 + 0·0355 = 0·323 lbs. H_2O ; 0·323 × 1236 = 399 B.T.U. ; 366 + 399 = 755 B.T.U.

The calorific value of the bagasse as fired is 3609 B.T.U. ; 3609 — 755 = 2844 B.T.U. per lb. ; and deducting 5 per cent. for radiation = 2702 B.T.U.

The actual heat absorbed by the water in the boiler is 2702 B.T.U. per lb. of bagasse, giving a fuel efficiency of 75 per cent.

One lb. of bagasse will evaporate 2·65 lbs. of water at 100 lbs. boiler pressure. The volume of the gases from the moisture at 32° F. is :—

	Lbs.
Hydrogen 0·032 × 9	= 0·288
Moisture in bagasse	= 0·48
Introduced by air 3·55 × 0·01	= 0·0355
	0·7955

And 0·7955 × 20 = 15·9 cub. ft.

The volume of the flue gases at 500° F. is :—

CO_2 = 6·5 × 1·95 = 12·67
CO = 0·424 × 1·95 = 0·82
O = 2·16 × 1·95 = 4·21
N = 34·2 × 1·95 = 66·7
H_2O = 15·9 × 1·95 = 31·0

115·4 cub. ft.

That is, the volume of flue gases from 1 lb. of bagasse using 31 per cent. excess air = 115 cub. ft.

Taking a factory crushing 50 short tons of cane per hour with 16 per cent. fibre, bagasse per cent. cane = 34 per cent. = 34,000 lbs. of bagasse per hour. The bagasse consists of 47 per cent. fibre, 4 per cent. sugar and 48 per cent. water.

From the calculations, 1 lb. of this bagasse will evaporate 2·3 lbs. of water; 34,000 lbs. of bagasse will therefore evaporate 2·3 × 34,000 = 78,200 lbs. of water. 1 sq. ft. H.S. evaporates 2·9 lbs. of water per hour, therefore to burn 34,000 lbs. of bagasse : 78,200 ÷ 2·9 = 26,965 sq. ft. H.S. 1 boiler h.p. = 34·5 lbs. water evaporated per hour; therefore 78,200 ÷ 34·5 = 2266 boiler h.p.

That is, the bagasse from 50 tons of cane is capable of developing 2266 boiler h.p.

Estimation of the Value of Different Kinds of Beet Seed.[1]

By Dr. EDWARD KOSTECKI.

All agree without exception that sporadic experiments for ascertaining the value of sugar beet seed are not only useless but indeed, harmful. Further, that the order in which the results are tabulated can be resolved in several ways, each of which has its justification, in view of all the parties interested, namely farmers, planters, seed producers, etc.

Mr. STANISLAW JACOBSON[2] suggests classification "according to number values" obtained from the summing up of the figures indicating the places occupied by a given brand of seed in its order according to the sugar yield and according to the percentage of sugar in the beet when the smallest number obtained gives the highest place to the seed, etc. But this method consists in adding up numbers which do not possess a common factor. Tabulation according to the sugar yield would be free from reproach, as the sugar percentage and the yield of the beet would be reduced to a common factor in the paragraph giving the yield of sugar, but this common factor is not sufficient for arriving at a proper economic valuation of the seeds of various brands. By carrying out the valuation on these lines the Vilmorin "half-sugar" beet would occupy the first place, though it is true that fodder beets are not taken into account by the sugar industry. At the same time one can see that sugar beet giving a very large yield and containing a small quantity of sugar would by this method of tabulation occupy a leading place without any justification.

So, obviously, this is not the way to determine the economic value of the respective sugar beet seed. A truer method of determining its economic value and order is that of calculating the gross profit obtainable from the manufacture of the beet grown from the different brands of seed. The profit is ascertained by taking into account the value of the sugar produced from one hectare, the cost of purchase and of manufacture into sugar of the beet growing on that hectare. As a basis of calculation the following figures are taken: (1) In order to calculate the possible profit obtainable from the manufacture of the beet grown on one hectare, we must disregard the percentage of sugar in the beet, taking into account the percentage of sugar actually obtained from its manufacture, that is from 2·5 to 2·8 per cent. of sugar less than what would be the percentage of sugar in the beet. (2) As a basis for the value of the actual sugar yield obtained from manufacture, the price of 55 zl. for 100 kg. is taken, that is approximately the average price of sugar sold in this country (Poland) and of that exported without duty during last year. (3) The cost of purchase of beet from the planter (3·10 zl.), transport (0·50 zl.), together with cost of the seed, cost of the contract and of receiving the sugar for one quintal (approximately) of sugar beet (1·2 zl.), the cost of manufacture of one quintal of raw material (0·70 zl.), a total of 5·5 zl., which does not include general costs.[1] After deducting the value of sugar obtained from one hectare of plantation, the cost of purchase, transport, manufacture. etc., of sugar beet from one hectare of the same plantation, i.e., sown with the same variety of seed, we obtain the gross profit from one hectare. According to this calculation the results of the trials during the last four years have been tabulated in Tables I, II, III and IV, reproduced herewith. (See pages 660 and 661).

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[1] Translated from the *Agricultural Gazette* (Poland), and here abridged.

[2] *Agricultural Gazette* (Poland), No. 8, p. 167.

It is seen from these tables that the economic value of the seed, expressed in the gross profit derived from a hectare, is not identical either with the order of the percentage of sugar, nor with the yield of sugar, nor with the yield of beet per hectare. The difference in profit derived from using seed giving the highest yield as opposed to that giving the most sugar would (see Tables I, II, III and IV) work out as follows :

1922.. .. 328·7 q. — 306·1 q. = 22·6 q. at 3·10 Zl = 70·06 Zl.
1923 .... 306·3 q. — 293·1 q. = 13·2 q. „ 3·10 Zl. = 40·92 Zl.
1924.. .. 329·0 q. — 311·6 q. = 17·4 q. „ 3·10 Zl. = 53·94 Zl.
1925 .... 293·6 q. — 282·5 q. = 11·1 q. „ 3·10 Zl. = 34·41 Zl.

Total .. .. .. 199·33 Zl.

In the meantime the loss from manufacture of the high yielding sugar beet as opposed to those most profitable to the sugar factory would work out as follows for the same years :

1922 .. .. 1065·90 — 1025·20 = 40·70 Zl.
1923.. .. .. 965·80 — 911·30 = 54·50 Zl.
1924 .. .. 1016·40 — 839·90 = 176·50 Zl.
1925.. .. .. 800·20 — 665·50 = 134·70 Zl.

Total .. .. .. 406·40 Zl.

Mr. Heise, the Secretary of the Seed Section of the Central (Polish) Agricultural Society, has made elaborate calculations, from which he proves that with an increase in the cost of manufacture the sugar beet seeds which give the greatest amount of sugar become the most profitable. An increase in the price of sugar with the cost of manufacture remaining stationary is in favour of the most productive kinds of seed. Obviously the figures given in the above tables in the paragraph " Gross Profit " cannot be treated as actual profit, but are only comparative figures with a view to tabulating the order of the different kinds of seeds in regard to their economic value.

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[1] Zl. = zloty ; 43 zl. = £1.

Estimation of the Value of Different Kinds of Beet Seed.—*Continued.*

TABLE I.—1922.

Number allotted in trial.	Firm.	Percentage of Sugar in the Beet.	Yield of Beet per hectare.	Yield of Sugar per hectare.	Percentage of Sugar obtained from Manufacture.	Actual yield of Sugar obtained from 1 hectare.	Value of Sugar obtained from 1 hectare.	Cost of Purchase and Manufacture of Beet on 1 hectare.	Gross profit from 1 hectare.
4	A. Janasz	18·83	306·1	57·64	16·33	49·99	2749·5	1683·6	1065·9
5	A. Janasz (2nd entry)	18·86	301·3	56·83	16·36	49·29	2711·0	1657·2	1053·8
1	Gebr. Dippe.	18·36	324·0	59·69	15·86	51·39	2326·5	1783·0	1044·5
3	Rabbethge & Giesecke	18·17	328·7	59·72	15·67	51·51	2833·1	1807·9	1025·2
10	Sand. Hodowia Nasion	18·35	313·6	57·55	15·85	49·71	2734·1	1734·8	1009·3
9	H. Matte	18·12	314·9	57·06	15·62	49·19	2705·5	1732·0	973·5
6	K. Buszczynski N.M.	18·36	300·6	55·19	15·86	47·68	2622·4	1653·3	969·1
11	"Motycz"	18·38	296·8	54·55	15·33	47·13	2592·2	1632·4	959·8
7	Delitsch	18·03	313·4	56·51	15·53	48·67	2676·9	1723·7	953·2
8	Wl. Mayzel	17·86	314·5	56·17	15·36	48·31	2657·1	1729·8	927·3
2	Jerzy Ryx	18·81	290·9	53·70	15·71	46·33	2548·2	1622·0	926·2

TABLE II.—1923.

4	"Udycz"	18·49	293·1	54·19	15·99	46·87	2577·9	1612·1	965·8
11	Sand. Hodowla Nasion	18·28	298·4	54·55	15·78	47·09	2599·0	1641·2	948·8
12	Kuhn, Naarden	18·24	296·4	54·06	15·74	46·65	2665·8	1630·2	935·6
3	A. Janasz	18·29	290·0	53·04	15·79	45·79	2518·5	1595·0	923·5
6	Rabbethge & Giesecke	17·91	306·3	54·86	15·41	47·20	2596·0	1684·7	911·3
10	"Motycz"	18·00	293·6	52·85	15·50	45·51	2503·1	1614·8	888·3
1	"Granum"	18·12	285·0	51·64	15·62	44·52	2448·6	1567·5	881·1
13	Buszczynski P.	18·19	280·8	51·08	15·69	44·06	2423·3	1544·4	878·9
7	W. Mayzel	17·77	302·8	53·81	15·27	46·24	2543·2	1665·4	877·8
9	Buszczynski N.M.	18·07	286·1	51·70	15·57	44·55	2450·3	1573·6	876·7
5	Buszczynski N.M.	18·04	280·1	50·53	15·54	43·53	2394·2	1540·6	853·6
8	A. Helczynski	17·67	296·9	52·46	15·17	45·04	2477·2	1633·0	844·2
2	Jerzy Ryx	17·93	281·2	50·42	15·43	43·39	2386·5	1546·6	839·9

TABLE III.—1924.

3	A. Janasz	18·43	311·6	57·43	15·93	49·64	2730·2	1713·8	1016·4
1	Sand. Hodowla Naison	18·15	324·3	58·86	15·65	50·75	2791·3	1783·7	1007·6
2	Buszczynski P.	17·94	317·7	57·00	15·44	49·05	2697·8	1747·4	950·4
7	" Udycz "	18·16	302·7	54·97	15·66	47·40	2607·0	1664·9	942·2
4	Kuhn, Naarden	17·73	308·8	54·75	15·23	47·03	2586·7	1698·4	888·3
6	" Granum "	17·69	301·0	53·25	15·19	45·72	2514·6	1655·5	859·1
11	" Motycz "	17·79	291·1	51·79	15·29	44·51	2448·1	1601·1	847·0
10	" Granum " (2nd entry)	17·67	296·7	52·43	15·17	45·01	2475·6	1631·9	843·7
8	A. Helczynski	17·14	329·0	56·39	14·64	48·17	2649·4	1809·5	839·9
9	Rabbethge & Giesecke	17·44	309·0	53·89	14·94	46·16	2538·8	1699·5	839·3
5	Jerzy Ryx	17·69	292·7	51·78	15·19	44·46	2445·3	1609·9	835·5
13	W. Mayzel	17·37	305·0	53·12	14·87	45·47	2500·9	1681·9	819·0
12	Buszczynski N.M.	18·01	266·3	47·96	15·51	41·30	2271·5	1464·7	806·9

TABLE IV.—1925.

1	Sand. Hodowla Naison	17·65	282·5	49·86	15·15	42·80	2354·0	1553·8	800·2
5	" Udycz "	17·42	278·2	48·46	14·92	41·51	2283·1	1530·1	752·0
3	A. Janasz	17·72	256·0	45·36	15·22	38·96	2142·8	1408·0	734·8
10	Buszczynski P.	17·38	268·4	46·65	14·88	39·94	2196·7	1476·2	730·5
4	Buszczynski N.M.	17·50	260·6	45·61	15·00	39·09	2150·0	1433·3	716·7
8	" Udycz " (2nd entry)	17·29	271·3	46·91	14·79	40·13	2207·2	1492·2	715·0
9	" Motycz "	17·38	265·3	46·11	14·88	39·48	2171·4	1459·2	712·2
6	" Granum "	17·37	265·8	46·17	14·87	39·52	2173·6	1461·9	711·7
2	Jerzy Ryx	17·12	275·1	47·10	14·62	40·22	2212·1	1513·1	699·0
7	Original-Kleinwanzleben	17·06	275·5	47·00	14·56	40·11	2206·1	1515·3	690·8
11	A. Helczynski	16·62	293·6	48·80	14·12	41·46	2280·3	1614·8	665·5

Important Colloid Problems in Cane Sugar Production which should be Investigated.[1]

By H. S. PAINE.
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Although advance has been made recently in determining the most favourable *pH* for liming cane juice, this point has still not been sufficiently definitoly determined, particularly with reference to various types of juice. This brings up the question of the relation between the character of cane and juice on the one hand and the character and quantity of colloidal substances on the other. There appears to be no doubt that both the quantity and the nature of the colloidal substances in juice are affected by a considerable number of factors such as intensity of milling and juice extraction, which is the principal factor in the mill, and by various agricultural influences such as soil, degree of maturity and variety of the cane, and deterioration of the cane as a result of the action of moulds, bacteria, yeast, etc., on cane damaged by burning, insect attack, frost, etc.

Colloidal substances may actually be produced as by-products of the action of these micro-organisms, or the tissue of the cane may be so modified as to permit extraction of greater quantities of colloids by milling. The degree of maturity of the cane is of considerable importance, since this determines the relative proportions of so-called "hemicelluloses" and cellulose. The compounds which constitute the group of "hemi-celluloses" are present in greater proportion in immature cane, and since these consist predominantly of colloidal substances of a high degree of hydration or water-binding capacity, a greater quantity of highly hydrated colloids of objectionable type will be extracted from the juice of such cane by milling.

The question arises whether under these variable conditions the juice should be limed to the same *pH* in order to obtain the maximum colloid elimination effect. This in turn raises the question as to how this maximum clarification effect is to be defined. Does optimum clarifiction mean producing juice with greatest clarity, or with least colour, or with greatest non-sugar elimination, etc ? Evidently, there are a number of factors which are to be considered as constituting good clarification. These may be stated as follows : (1) maximum elimination of non-sugars ; (2) maximum elimination of colloidal substances ; (3) maximum clarity of juice ; (4) minimum colour ; (5) maximum rate of settling of mud ; (6) minimum volume of settled mud ; (7) minimum Ca content ; (8) a *pH* value of clarified juice such that inversion does not result at a later stage. In such an investigation non-sugar elimination should be determined as actual weight (instead of volume) of mud. The organic content of the mud, determined by difference between total weight and ash, is a still more specific criterion.

It is evident that some of these requirements are incompatible, for instance, maximum elimination of non-sugars or colloids on the one hand, and minimum volume of mud on the other. It is important, nevertheless, to ascertain the optimum *pH* for each of these factors for the same lot of juice. For determining colloid elimination the most sensitive and specific colloid investigational methods should be used. It is then desirable to compare the optimum *pH* values for these various factors obtained for one lot of juice with the optimum *pH* values found for other types of juice representing such variations as have just been discussed, for instance, juice from immature cane, juice from burned cane, etc. Comparison of these various factors between different lots of juice should be made at the same liming *pH* value.

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[1] Extracted from a paper published in *The Reference Book (The Planter)*, 1926.

An investigation along the above lines was conducted by PAINE and KEANE[1] during the present season, using for determination of colloids such methods as surface tension and the Night Blue dye test. Juices of different types were defecated at *pH* values varying between 7·0 and 9·0.

MCALLEP and BOMONTI[2] have shown that for efficient clarification the phosphoric acid (P_2O_5) content of the juice should not be less than 0·30 to 0·35 grms. per litre, and the influence of calcium phosphate precipitation as a basic factor in the removal of colloidal substances in the defecation of cane juice has been elucidated by Bond[3]. In this connexion the question arises as to what extent the optimum *pH* is governed by the P_2O_5 content and the optimum range of hydrogen-ion concentration for calcium phosphate precipitation and to what extent it may be controlled by variation in the quantity and the specific character of the colloids present in the juice. In the former case the influence of *pH* on colloid elimination would arise in a more indirect manner than in the latter instance. BOND states that "after sufficient precipitate has been formed very little is gained by additional precipitation, and for this reason the addition of phosphates to juices cannot be justified unless the phosphate content is too low."

Another problem which can be cleared up by the use of colloid investigational methods is the question of the formation of so-called " caramelization " products as a result of " overprocessing " of liquors, or too much return and boiling of centrifugal run-offs prior to exhaustion. The colour of the scales of the reversible colloid fraction is undoubtedly due to such caramelization products, as are also some of the more highly dispersed coloured compounds which pass through an ultrafilter.

Investigation of the change in dispersion of colloids remaining uneliminated after defecation is also important. For instance, a clarified juice of a high degree of clarity may, upon concentration, become relatively turbid, owing to aggregation of the small colloidal particles into larger particles. This may have an important influence upon the quality of sugar produced.

With more sensitive and specific testing methods available, by which colloid behaviour can be directly determined, it will be possible to readily detect differences in juice and sugar liquors which are not now apparent by ordinary control methods, but which nevertheless have a very definite influence upon factory operation and the quality of sugar produced. One important result of continued investigation along this line will be to evaluate in definite terms the possibilities of colloid elimination by the present standard methods such as ordinary lime defecation, sulfitation, and carbonation. It is no doubt true that during the course of the large number of experiments and observations that have already been made over a long period of years, practically all conditions and combinations of conditions such as temperature, time, quantity of lime added, extent of sulphuring and carbonating, etc., etc., have already been tested. Nevertheless, because of the lack of specific colloid testing methods, it has been impossible to arrive at definite and final conclusions regarding the combination of conditions required to obtain maximum defecation and clarification effects from all standpoints. This situation has been further complicated by the fact that the juice used in making these observations has varied considerably in character, and on account of the lack of specific testing methods there was no way in which this variation in juice from the colloid standpoint could be definitely evaluated and stated in precise terms so that allowance therefor could be made in the results obtained.

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[1] *Ind. Eng. Chem.*, 1925, 17, 492, [2] Paper to be published soon. [3] *Cf* 1.

It is believed that the time is now at hand when the optimum combination of conditions for each of the standard clarification processes can be definitely evaluated from the standpoint of colloid elimination and the various effects such as turbidity, viscosity, etc., which result from uneliminated colloids. It will then be in order to start more comprehensive investigations looking toward improvements in these processes which can be made within permissible limits of cost.

The Hydrogen-Ion and its Application to the Sugar Industry.[1]

By H. F. BOMONTI.

For many years the sugar industry has used two indicators, litmus paper and phenolphthalein, it having been common practice to lime mixed juice slightly acid to litmus paper, or possibly neutral to litmus, while within the last few years the practice in Hawaii has been to lime to neutrality to phenolphthalein. Many may find it hard to think in the terms of *pH*, but as a matter of fact, the *pH* or hydrogen-ion concentrations of juices have been determined, though these reactions have been referred to litmus and phenolphthalein neutrality.

When a solution is at the neutral point to litmus paper or phenolphthalein, it is actually a solution of a definite hydrogen-ion concentration, the *pH* or hydrogen-ion concentration at which an indicator changes from one colour to another, being called the neutral point of the indicator. When a solution is neutral to litmus paper, the hydrogen-ion concentration is about 6·5 *pH*, while the neutral point of phenolphthalein is 8·3 *pH*. Where reactions were made by titrating with an acid or alkali, and the results expressed in grms. CaO per 100 c.c., or so many c.c. of N/10 acid or alkali, it was always with respect to one of the above-mentioned indicators. It was supposed, and for that matter actually still is, that these reactions indicated the proper degree of acidity or alkalinity.

There are several inherent objections to the former system of expressing reactions, and to the indicators themselves. In the first place, litmus paper is not a reliable indicator. It is influenced by the presence of salts, besides being indefinite and not very sensitive. On the other hand, phenolphthalein is a reliable indicator, but the fact that it is colourless at *pH* values below 8·3 *pH* makes it undesirable.

Expressing reactions in terms of grms. CaO per 100 c.c. requires time, and is very unreliable. Due to the presence of certain salts in cane juices, the reaction expressed in grms. per 100 c.c., or in c.c. of N/10 acid or alkali, may vary considerably without any variation in the *pH*, or vice versa. For example, we have had many instances at the Experiment Station where mixed juice might have a reaction of 0·011 acid to litmus and a *pH* of 5·9, while at other times a mixed juice sample would have a reaction of 0·025 grms. CaO per 100 c.c. acid to litmus and a *pH* of 5·9. When we determine the reaction of clarified juice, we find the same variations in reactions for juices having the same *pH*. For example, we cannot say that the most desirable reaction for limed mixed juice is exactly 0·010 or 0·015 because of this variation. All we can say is, that between certain limits, we can expect the most desirable results.

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[1] Report (here abridged) presented to the Association of Hawaiian Sugar Technologists, October, 1926.

The reason for these variations in reactions and *pH* values is the buffer effect produced by some salts which are present in juices in varying concentrations. A buffer can be defined as a salt, such as a phosphate, which permits the addition of comparatively large quantities of an acid or alkali with relatively small changes in the hydrogen-ion concentration of the solution. The buffer action of phosphates is very clearly demonstrated in an experiment which the writer carried out about four years ago. A sample of mixed juice was secured from the Oahu Sugar Company which had a P_2O_5 content of 0·005 per cent. To seven equal portions sufficient potassium acid phosphate was added so that the final P_2O_5 concentrations were 0·025, 0·045, 0·065, 0·105, 0·125 and 0·145 per cent. Equal portions (viz., 10 c.c.) of the original and the seven mixtures were then titrated in the following manner : First, the *pH* of the sample was determined, then small quantities of N/28 alkali were added. After the addition of each c.c. of alkali, the *pH* value was determined until the juice had a *pH* of about 9·0. The eight samples were titrated in like manner. The curves showed a pronounced flattening out as the P_2O_5 content in the juices increased, which flattening out is known as the buffer effect. The c.c. of N/28 NaOH required to increase the *pH* of samples from 6·0 to 8·5 *pH* appear in column three of the table given below ; while in column four are the reactions expressed in grms. CaO per 100 c.c. referred to 6·0 *pH*.

Curve No.	Per cent P_2O_5	C.C. N/28 NaOH	Reactions.
1	0·005	1·4	0·014
2	0·025	2·2	0·022
3	0·045	3·1	0·031
4	0·065	3·9	0·039
5	0·085	4·6	0·046
6	0·105	5·4	0·054
7	0·125	6·3	0·063
8	0·145	7·0	0·070

It is because of the above-mentioned reasons and also because of the fact that the inversion of sucrose depends not upon the quantity of acid present, but on the hydrogen-ion concentration, that *pH* values were applied to the sugar industry. By actual experiment, the Station determined the *pH* values at which one secures the maximum increase in purity, the *pH* at which the minimum amount of inversion takes place, and the *pH* at which glucose is destroyed during clarification.

Briefly stated, the maximum increase in purity is generally secured when the mixed juice is limed to 8·3 —8·5 *pH*. While there may be a slight precipitation beyond this *pH*, the lime salts increase to such an amount that the purity secured will be less than the maximum. The destruction of glucose which occurs during clarification first becomes evident at 8·25 *pH*, so that at 8·3—8·5 *pH*, only small amounts are affected.

The inversion of sucrose in juices depends on three factors : time, temperature and *pH*. For ordinary practice, where the juice is not in process more than two hours, an initial *pH* of the limed mixed juice of 8·3—8·5 *pH* may be considered safe. Where a longer time is involved, the temperature must be decreased.

The *pH* value of raw mixed juice is simply the hydrogen-ion concentration of the juice. When a juice is limed we change the hydrogen-ion concentration, but from the *pH* of the juice we cannot tell how much lime is required, the lime requirement of a juice depending largely on the P_2O_5 content of the juice. It is evident, therefore, that the lime requirements may fluctuate considerably.

Filter-Press Operation.[1]

WALTER E. SMITH.

The methods and results of a series of experiments made at different factories, wherein the rate of flow of juice from the press was measured and the resulting data plotted for analysis, are described, the principal developments of interest being as follows :—

In a first series of tests, using 12 lbs. pressure from a gravity feed system, it was found that the maximum over-all capacity of the press, including washing and cleaning, was obtained in from 2 to 2½ hours after the start, providing the flow was allowed to proceed rapidly at the start of operations. These data were confirmed by a similar series, using 20 lbs. pressure from a gravity head at another factory. In a third series a comparison was made between rapid filling at the start, and a more extended cycle in which the pressure was allowed to build up very slowly. The data indicated no advantage from the slower filling. On theoretical grounds the slow initial rate of flow may seem logical, but actual data fail to indicate any deleterious effect from a more rapid operation.

An experiment is described in which the effect of " Hy-flo Supercel " as a filter-aid was tested under factory conditions. The addition of ½ lb. of " Supercel " per ton of cane gave a very slight increase in rate of flow over regular operation, while a more marked improvement followed the use of 1 lb. per ton of cane. A much better effect was obtained by substituting an 8 × 8 mill screen for the 16 × 16 formerly in use ; a slight increase in mud per cent. cane, together with a slight decrease in mud polarization followed the use of the coarser screen. No reduction in polarization accompanied the use of " Supercel," and since the polarization would need to be reduced 2 per cent. to justify the use of 1 lb. of this material, the conclusion is that the use of filter-aid at the factory in question would not seem justified.

From another factory data were obtained giving the composition of the sweet-water taken from the outlet cocks and the total run-off from the presses, including leakages, the former having an average polarization three times greater than the latter. The quantity of water which actually passed through the cake was computed to be only 85 per cent. of the weight of the cake, the polarization of which was 0·8 per cent. Leakage brought the total press wash-water to more than three times the volume of that which actually passed through the cake. It is pointed out, in further reference to the pressure carried on the wash-water line, that if the capacity of the leaks to discharge wash-water was large in proportion to the capacity of the water ports, the final pressure available for forcing water through the cake may be but a fraction of that indicated at the main.

In discussing the performance of various types of pressure arrangements for feeding the presses, preference is expressed for the gravity feed system, centrifugal pumps being preferred to reciprocating pumps, principally because of the lack of flexibility in capacity of the latter.

One of the most important factors in filter-press operation is a proper adjustment of pressures. From 15 to 20 lbs. should be sufficient for filtration proper ; while for washing, there seems to be no good reason why 35 to 40 lbs. pressure should not be advantageously applied if the mechanical condition of the presses permits.

There is a general tendency to have the temperature of the wash-water too low. Bacterial activity within the presses is not inhibited unless the temperature is maintained at or above 165° F. When the condensate from the evaporators is the supply, this temperature is not always maintained, especially when the water is cooled by the injection of cold water to facilitate the withdrawal of the condensate in the last cell. The use of exhaust steam for heating the press wash-water to 180-190° should be justified, since the heat contributes to the temperature of the press washings and is thus recovered almost entirely.

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[1] Abstract from a very complete and detailed report by the same author, appearing in *Reports of the Association of Hawaiian Sugar Technologists.*

The return of sweet-water to the mills is a topic which can be studied with profit. The best method is the segregation of the actual press washings from the leakage, the former going directly to the boiling house with the press-juice, the latter going to the mill as maceration, or returned to the press-water supply tank if arrangements are made to maintain the temperature of this supply.

Imports of Sugar Machinery into Java during 1925.

(American Commerce Report.),

During 1925, the total value of imports into Java of sugar machinery, excepting power transmission plants (and parts thereof, such as boilers, steam turbines, steam pumps, etc.), and machine tools, amounted to 9,095,000 guilders ($3,652,552), against 7,829,000 guilders ($2,991,461) in 1924, the increase of well over 1,000,000 guilders being ascribable to the better profits made by the mills, as a result of increased production and favourable prices. From 32,500,000 piculs (picul equals 136 lbs.) in 1924, which was then the highest figure reached locally, sugar production in 1925 broke all previous records, being nearly 5,000,000 piculs above that of the preceding year.

The price of sugar during the past year was generally at a lower level than in 1924, but the enormously increased output of sugar in 1925 has not only amply compensated for this slight setback of price but has also enabled the industry to spend considerably more money on new equipment than in 1924 or several previous years. An indication of this is found in the fact that during the first four months of 1926 imports for account of the sugar industry had already amounted to 5,205,000 guilders ($2,088,246), or more than half the value of the total 1925 imports. The current year's imports may, therefore, be safely estimated as well over 10,000,000 guilders. The prospects for 1927, however, are poor, as production this year on most plantations has so far fallen considerably below that of 1925, while there is yet little or no indication that this will be compensated for to any appreciable extent by higher prices.

IMPORTS OF SUGAR MACHINERY INTO JAVA BY COUNTRIES OF IMMEDIATE ORIGIN.

Country of origin.	1924. $	1925. $	January-April, 1926. $
The Netherlands	2,286,869	2,687,507	1,464,380
Great Britain	372,548	423,286	308,924
Germany	241,105	442,563	306,918
United States	54,258	37,750	——
Belgium	19,869	37,349	7,222
Italy	6,114	14,458	401
France	3,439	7,630	401
Sweden	6,878	2,008	——
Other countries	382	——	——
Total	2,991,462	3,652,551	2,088,246

Holland holds an outstanding position as a source of sugar mill machinery for this market, according to the official Netherlands East Indian statistics. These returns, however, are given by country of immediate rather than primary origin, and it is probable that some of the sugar mill machinery credited to Holland is of German origin. Much of the sugar mill machinery entering Java is purchased through the head offices in Holland of the Java sugar mill companies.

The Sugar Campaign of 1925-26 in Czecho-Slovakia.

The Czecho-Slovakian sugar campaign of 1925-26 has exceeded the results of all previous periods. The total production amounted to 754,459 tons, whereas in the previous campaign it only reached 714,259 tons (in value of raw sugar). The increase of the sugar production in the 1925-26 campaign is therefore 40,200 tons, or 5·6 per cent.

In Bohemia 378,171 tons have been produced in 1925-26 against 382,792 tons in the previous year. In Moravia the total production amounted to 238,407 tons against 227,491 tons in the previous campaign. The Silesian production rose from 7,262 tons in 1924-25 to 8,464 tons in 1925-26.

In Slovakia the total production of sugar in 1925-26 was 129,415 tons compared to 96.713 tons in the previous campaign, an increase of about a third, which is the largest obtained in any district of the Czecho-Slovakian Republic during the last campaign.

In Bohemia during the period from October 1st, 1925, to September 30th, 1926, the quantity of sugar released for home consumption was 97,702 tons (in value of raw sugar) compared to 94,529 tons in the same period of 1924-25. In Moravia the respective figures were : 74,844 tons and 66,638 tons, whereas in Silesia the quantity of sugar released for home consumption in the 1925-26 campaign was only 6,778 tons against 10,313 tons in the previous campaign. In Slovakia the release for home consumption in 1925-26 amounted to 24,849 tons against 23,549 tons in the year 1924-25.

The total export of the whole campaign (1st October, 1925, to 30th September, 1926) reached the quantity of 540,235 tons against 507,577 tons in the previous campaign ; the increase was 32,658 tons, or 6 4 per cent.

Bohemia exported during the last campaign 296,555 tons against 280,377 tons in the campaign of 1924-25. The export of Moravia during the same periods amounted to 152,229 tons and 141,589 tons respectively. In both cases an increase has taken place, whereas the export from Silesia has dropped to 6,606 tons in the campaign of 1925-26 from 12,285 tons in 1924-25. The largest increase of exports falls to the share of Slovakia ; the quantity of sugar exported from this district was 84,844 tons in the campaign of 1925-26 compared to 73,325 tons in that of 1924-25, which means an increase of 15·7 per cent.

The reserves of sugar carried over into the new campaign of 1926-27 amounted to 21,862 tons (in value of raw sugar) against 17,769 tons in the previous period.

Of the total quantity of sugar produced in Czecho-Slovakia during the campaign of 1925-26, 71·6 per cent. falls to the share of export and only 27·1 per cent. to home consumption ; the respective figures of the previous campaign were 71 per cent. and 21·7 per cent.

Publications Received.

Wärmewirtschaft in der Zuckerindustrie (Heat Economy in the Sugar Industry). By Karl Schiebl. Volume II of the Series " Warmelehre und Warmewirtschaft in Einzeldarstellungen. With 83 illustrations and 44 tables. (Verlag von Theodor Steinkopff, Dresden and Leipzig.) 1926. Price: 10 RM.

This is a very useful small book which reviews in a general way steam practice in Continental beet sugar factories and refineries, and is especially valuable for the clear information it gives on the developments which have led to the more recent innovations, viz., the system of evaporation under pressure, the use of high pressures and the use of Ruth's steam economizer. The first part comprises a survey of the history of steam in the sugar industry, of methods of beet sugar manufacture, and of demands on steam in the sugar-house. The second half of the book treats of evaporation in connexion with heating, total steam consumption, the boiler-house, coal consumption, and the heat balance. Special chapters are devoted to operating with systems that produce an excess of energy, and to working with the " heat pump." Lastly, in a chapter entitled " Examples from Practice," are given specifications of factories working under seven different systems, in four of which Ruth's steam economizer is part of the installation. This is a volume which should find a place in the library of the engineer claiming to be well documented in respect of modern ideas on the economy of steam and of fuel in the sugar industry, more especially in beet sugar manufacture.

Norit: and its Applications in the Beet Sugar Industry. (General Norit Co., Ltd., Den Texstraat 2, Amsterdam, Holland.) Gratis: on application.

" Norit " decolorizing carbon is treated in this 78-page booklet more particularly from the point of view of the beet sugar manufacturer turning out white sugar in competition with the product of the refineries, for which purpose it is used in Bohemia, Holland, Belgium, Denmark, France, Germany, Italy, and now also in the United Kingdom. Its nature, composition, and properties are here treated; a comparison is made between it and the bonechar process; and a list is given of the " Norit " patents. In the main the booklet treats of the application and the revivification of this carbon in the refinery and in the white sugar factory. Cost calculations are given for these two applications. It is stated that in a refinery of a capacity of 200 tons daily, with a carbon addition of 0·5 per cent., and a loss of 1 per cent. per regeneration, the total cost of carbon, coke, freight and expenses, filter-cloths, chemicals, and labour will work out at 11d. per ton of sugar refined. In the white sugar factory the cost will vary a good deal according to the procedure, but the figure here given is 4d. per ton of sugar made. In addition to " Standard " Norit," there are grades of " Supra-Norit " designated as " 2x " or " 3x," etc., according to its power of adsorption of impurities, as compared with " Standard Norit, A Grade." It is of interest for those who do not desire to revivify to note that a specially low-priced grade of carbon having a superior decolorizing power and filtration capacity compared with " Standard Norit," is now on the market. It has an inferior power of revivification, but is of considerable significance to those whose idea is to reject the carbon after having used it once. This is a very well-written booklet, which should be in the hands of all concerned in the production of white sugar.

Jahr-und Adressbuch der Zuckerfabriken (Year and Address Book of Sugar Factories). 1926-27. Edited by A. Artur Schallehn. Fifty-sixth year of publication. (Verlagsanstalt fur Zuckerindustrie, Magdeburg, Germany.) **Rathke's Jahr-und Adressbuch der Zuckerindustrie.** 1926-27. Forty-second year of publication. (Albert Rathke, Magdeburg.)

These two reference books give lists of factories principally on the Continent, and in addition a deal of useful information relating to the beet sugar industry in Germany, Czecho-Slovakia, Austria, France, Belgium, Holland, Russia, and elsewhere.

Brevities.

"Exchange of trade information between competitors is essential if the full harvest of improved technical knowledge is to be reaped.[1] Such a policy is largely practised in America, not for altruistic reasons, but because it has been found to pay."

Mr. H. H. DODDS,[2] Director of the Natal Sugar Experiment Station, recently gave the following average figures for the fibre content in different countries: Natal, 16; Cuba, 10·7 in 1923 and 10·3 in 1925; Hawaii, 13·0 in 1920 and 12·7 in 1924; Mauritius, 12·2 in 1924; Honduras, 11; and Mexico, 10 per cent.

Experiments are being carried out at several of the beet factories for the purpose of determining the effect on sugar beet of "clamping," or storing in heaps under various conditions until required for slicing. It is hoped to arrive at a method of storing roots in this way, under the conditions of which loss of weight and loss of sugar will be at their minimum.

Attention is called to the excellent course on the Bio-Chemistry of Fermentation, under Prof. ARTHUR R. LING, M.Sc., F.I.C., at the University of Birmingham. The scheme of study followed comprises: (1) Post intermediate year (chemistry and botany); Final B.Sc. year (chemistry and bio-chemistry of fermentation); and (3) Honours B.Sc., or diploma year (bio-chemistry of fermentation, or malting and brewing).

The annual report of the Orchard Sugar Co. Ltd., of Greenock, lately issued shows that for the period from May 8th, 1925 to March 31st, 1926, a loss of £40,889 was incurred, plus a sum of £1325 paid as dividend on the preference shares. In May, 1925, this company made a public issue of 50,000 73 per cent. cumulative preference shares and 80,000 ordinary shares of £1 each in order to acquire the refinery and other properties of the Orchard Sugar Refining Co. of Greenock. An advance of £80,000 was also made to the Company under the Trade Facilities Act.[3]

The last report of Leach's Argentine Estates Ltd. shows that this Company has suffered severely by the world drop in sugar prices. For the year ending last March in spite of a reduction of 14 per cent. in costs of production and an increase of nearly 7000 tons in the amount of sugar turned out, the trading profit dropped from £244,613 to £15,565, and the net results for the year 1925-26, after allowing for depreciation and debenture interest, was a loss of £74,111 against a profit in 1924-25 of £118,083. As a result, the reserve account is reduced to £237,372. The Company's freehold estates, etc., stand at cost, at £2,091,765, while the original amount paid for goodwill in 1912—£132,700—remains unextinguished.[4]

A leading member of the National Farmers' Union recently told a gathering that the Continental beet sugar industry had a substantial number of efficient agricultural workers and got their labour at a very low cost. The German beet growers, for instance, paid for their labour considerably less than half what it cost in this country. Where there was not sufficient labour on the spot in Germany, the numbers were made up by migration-labour from Czecho-Slovakia which came over just for the season. With these different conditions, it was obvious that sugar beet growing in this country would have great difficulty in competing with the Continental grower. But if the harvesting difficulty could be overcome by means of suitable machines, a considerable impetus would be given to the industry.

Prof. Sir JAMES C. IRVINE, F.R.S., the well-known investigator on the structure of the sugars, and Professor at the University of St. Andrews, was honoured at a banquet given by the Chicago Section of the American Chemical Society, being awarded the Willard Gibbs Medal on that occasion. Sir JAMES in an informal reply related that after spending some years in South America as a ranchman, he returned to Scotland at the age of 30 to begin his study of chemistry, later specializing on the carbohydrates with results known to all chemists. He himself presented to his Alma Mater a splendidly equipped chemical laboratory, generously endowed, in which students may work without payment on their part to pursue their own particular line of investigation.

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[1] *Executives Service Bulletin.*

[2] Proceedings of the Fourth Annual Congress, Durban, April, 1926, page 37.

[3] *Financial Times.* [4] *The Times.*

Brevities.

The death is announced in London, at the age of 62, of Mr. **William P. Reina Newlands**, only son of John A. Reina Newlands, whose name is known to all chemists as the discoverer of the "Law of Octaves." Mr. William Newlands was for some time engaged in sugar manufacture in India, but latterly had been in retirement at Streatham.

Experiments in jam making without boiling the fruit have been carried out successfully at the Fruit and Vegetable Preservation Research Station, Chipping Campden, near Evesham, Glos. Use of temperatures only high enough to hydrolyse the pectin substances without eliminating much of the flavouring bodies is said to have resulted in a product of finer flavour than made ordinarily.

We recorded in our July issue (page 350) the findings of the U.S. Court in the Fulton-Farrel lawsuit over the validity of the Fulton Double Crusher patent. This decision, which was in favour of the defendant company, the Farrel Foundry & Machine Co., was of course liable to be re-tried on appeal; but we now understand that no appeal has been lodged within the time allowed, so it must be assumed that the decision of the District Court of Connecticut is now made permanent.

The idea of controlling the "curly-top" disease of beets through development of resistant strains was suggested by observation of the fact that in the same field some individual plants were more resistant than others.[1] On the basis of this observation a few seemingly resistant beets were selected in the hope that a strain satisfactorily resistant to "curly-top" might be developed. In the investigations by the Department of Agriculture, Washington, a comparison showed 70 per cent. greater yields for beets of a resistant strain than that for commercial beets.

Mr. A. W. **Farquharson**, at present in England investigating the rum situation on behalf of the Jamaica Imperial Association, has reported to the effect that German flavoured rums are not consumed at all in Great Britain, and do not affect the market; that Wedderburn and Plummer rums should in planters' interests be reduced to prevent collapse in the British market; that the production of common clean rums should also be reduced; that the practicability of the production of industrial alcohol in Jamaica with existing plant or with inexpensive additions should be examined.

According to *Empire Production & Export* the trade returns of British Guiana for 1925 indicate the immediate effect of the increased preference granted by the United Kingdom to Empire sugar. The result has been to deflect a large quantity of this colony's exports of sugar to England. It increased from 28 per cent. during the first half of 1925 to 52 per cent. in the second half. The total export of sugar was 97,728 tons, and was with the exception of that of 1921 the largest since 1917. The price obtained has naturally, however, shown a serious falling off, in view of the low world price for sugar.

At the City of London College a course of training has been arranged for those engaged in the sugar trade. Lectures are delivered in Section I by Mr. S. J. **Duly**, M.A., on the "Scientific Study of Sugar" (its occurrence, production, refining, by-products, etc.); in Section II by Mr. C. J. **Robertson**, M.A., B.Sc., on the "Economic Geography and Statistics of Sugar" (cane and beet sugars, and the trend of commerce in sugar); and in Section III by Mr. **William O'Toole** (Secretary of the Sugar Association of London) on the "Marketing of Sugar" (contracts, the sugar trade, raw and refined, terminal market and clearing house).

In the new Hilger form of polariscope tube, the inner glass tube and its ends are in one integral piece. This tube lies within a water-jacket made of nickel steel having the same expansion as the glass. It is thus possible to fix the glass tube within the nickel tube with hard and highly resistent cement, a course which is not possible where the water jacket is composed of ordinary metals or alloys, since at the higher temperatures the different expansion between the metal and glass will cause fracture of the tube with cements of rigid and resistent character. The metal part of the tube is carried well over the ends of the glass tube, thus ensuring that the latter acquires the same temperature throughout. Temperatures up to 100°C. may be used with this tube, which is also claimed to withstand the most corrosive liquids.

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[1] *Circular 588-C.*, Dept. Agric., U.S.A.

Review of Current Technical Literature.[1]

DATA ON BAGASSE FURNACE DESIGN. **Sub-Committee of Natal Sugar Technologists' Association.** *Proceedings of the Fourth Annual Congress of the South African Sugar Association, Durban, April,* 1926.

After some remarks on the step-grate type of bagasse furnace, it is stated that there are many adherents of the flat-grate design, who contest its merits against the former. It is unquestionable that good results are obtained from it. Proportions and design are different to the step-grate, but the two are essentially alike in one main feature, viz., the roof of both must be as flat as possible, or must be of the segmental arch type rather than of the semi-arcular design, so that efficient radiation may result in order to evaporate the water in the entering bagasse. In regard to boiler heating surface, the usual figure quoted by authorities is 500 sq. ft. per ton of cane per hour, and from figures gathered from 12 Natal factories an average of 461 has been obtained with extremes of 338 to 620, though it must be noted that those factories showing the smaller values are in every case adding to their boiler plant. It is calculated that a boiler requires 1·12 lbs. of bagasse per sq. ft. of h.s.; so that, taking the weight of bagasse as being one-third that of cane, 595 sq. ft. of heating surface will be required per ton of cane. As to grate areas, for modern mills with finely crushed bagasse, a ratio of 100 of h.s. to 1 of grate area is considered good practice. Figures of 12 Natal factories show an average ratio of 78·2 to 1, varying from 57·9 to 120 to 1, the reason for this considerable variation being that factories whose heating surfaces are small have proportionately large grate areas or vice versa. In Natal 80 to 163 lbs. of bagasse is consumed per sq. ft. of grate area, and ideal conditions give the figures as being 112. Coming next to the furnace volume, the combustion chamber should not be of less capacity than ¼ cub. ft. per sq. ft. of h.s., though in Natal this rule is not adhered to, many being too small. In observing this rule, care should be taken that the furnace roof be not raised too high above the grate to spoil the radiation of drying action of the bagasse. Regarding the area of flues, that is of passages leading from the feed hopper to the chimney, the area of passage between furnace and heating surface or boiler should be in the case of water-tube boilers 1 sq. in. per sq. ft. of h.s., in the case of smoke-tube boilers $\frac{5}{6}$ in. per sq. ft., and for the passage after leaving the boiler $\frac{1}{5}$ in. per sq. ft. of h.s. Chimney draught is quite an involved question and each particular boiler plant must be studied on its own distinctive features which may include atmospheric humidity, altitude above sea level, use of waste gases in preheaters and economizers, total length of horizontal flues, and the like. Great stress must be laid on the discreet use of air for furnace purposes, and every factory should aim at satisfactory fuel combination and test their flue gases systematically, chemist and engineer collaborating closely to obtain the utmost efficiency in this important problem. Unavoidable loss of heat in the waste gases from the boiler is about 30 per cent. of the total heat in the bagasse, and by the efficient return of this heat into the furnace in the form of hot air by means of preheaters an increase of 22 per cent. in steam may be obtained. Then is mentioned that with properly designed economizers, say of 1½ times the boiler heating surface, an increase in steam production of from 10 to 20 per cent. may be expected.

BOILER AND FURNACE EFFICIENCY IN HAWAII. **William E. Smith.** *Reports of the Association of Hawaiian Sugar Technologists, October,* 1926.

In many cases in sugar factories, boilers that should give at least 75 per cent. efficiency will be found operating between 45 and 60 per cent. More attention should be given to providing proper apparatus for guiding the fireman, who very often, especially in the smaller plants, has nothing to guide him excepting "intuition." It is not always desirable to purchase expensive equipment; but such instruments as draught gauges, indicating flow meters, Orsat apparatus and at least thermometers, are necessary in the hands of capable men, who believe in them, and who can so interpret the data secured as to make profitable use of the information derived. But in any case to secure efficiency, the surface of the boiler must be clean inside and outside, and the gas passages must be free and unrestricted through the deposit of ashes; the baffles and settings must be reasonably free from leakage; and any accumulation of oil or grease must be thoroughly removed, the boiler being shut down as soon as practicable for so doing. In the T.H. the steam pressure is being gradually increased until at the present time 135 or 150 lbs. pressure is required, whereas only a few years ago it was thought that 80 or 100 lbs. was ample. With the horizontal return tubular type of boiler, the plates have been increased in thickness to $\frac{9}{16}$ and $\frac{5}{8}$ in. for the two pressures named respectively. But this thickness of plate has more tendency to crack on account of the thickness of the lap joints of the circumferential seams, and as the boiler increases in age there will be more trouble from cracked plates. No doubt there will be a call for yet higher pressures in the future, though, as the maximum thickness of plate has been reached in the horizontal return tubular boiler, it will be necessary to consider the water-tube boiler, which can be purchased in large units, bringing about a reduction in radiation, a higher degree of safety and a lower rate of depreciation. Water-tube boilers installed in the Islands several years ago and which use bagasse as fuel are generally found to be operating below rating. It has been found that with less height of the tubes and greater width of furnace, so as to increase the grate area, the rating has been increased in the Stirling type of boilers. It is also important to provide a large furnace volume, the boiler being raised high enough so as to install a high bridge wall, while the arch should have a drop nose so as to bring the gases down against the hot bridge wall. With a long Dutch oven, the gases are not so stratified and the high bridge wall brings about almost complete combustion before the gases come into contact with the steel work. The new installation of Stirling boilers at the mill of the Ewa Plantation Company is designed along this line and it is customary to obtain over 35 per cent. above rating with natural draught, using bagasse as fuel. It is very evident that this new design of furnace has brought up the operation of the water-tube boiler to a position where, with all factors taken into consideration, this type of boiler is now better fitted for operation in the sugar mills than the horizontal return tubular boiler. To ensure safety, no better guide exists than is now available in the Boiler Code of the American Society of Mechanical Engineers,[1] which gives a safe procedure regarding boiler construction, maintenance and inspection.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

EXTENT OF THE DRYING-OUT OF SUGAR STORED AT DIFFERENT ALTITUDES IN NATAL.

Duncan M. Eadie. *Proceedings of the Fourth Annual Congress of the South African Sugar Association, Durban, April,* 1926.

When the Weights and Measures Act (Natal) came into force in April, 1923, a question arose with the authorities about the definition of the "lawful weight" of a pocket of sugar in the regulations to be proclaimed under the Act. The S.A. Sugar Association decided to adopt 100 lb. and 50 lb. pockets, but a difficulty arose about the practicability of the proposal to adopt 100 lbs. as the "lawful weight" because it was suspected that while the full weight might be packed in the pocket at the factory there was a risk that there would be loss of weight due to drying-out if sold after being stored for some time in a dry climate such as that of Johannesburg. Arrangements were made for testing to what extent in actual practice sellers up country were exposed to risks of prosecution on account of drying-out in transit or storage up country. An experiment was organized which gave the required data and subsequent upon it the Weights and Measures Department decided to treat sugar for the purpose of the Act as an article not subject to variation in weight owing to climatic influences. The experiment was carried out in the following manner: Four sets of five bags each of typical sugars were collected at Durban, adjusted to weigh exactly 70 lbs. nett and tested for water content. One set was retained in Durban, and one set each despatched without delay to Johannesburg. Bloemfontein and Capetown. Arrangements had been made for storage under normal conditions, weighing on arrival, and thereafter monthly weighings. At the conclusion of the test all the sets were tested for moisture except those at Bloemfontein, where a chemist was not available at the time he was required for the work. The data were reported periodically to Durban by the Assize Officer in the town concerned, and careful records kept. At the same time, daily records of atmospheric humidity were obtained to serve as a secondary check on moisture fluctuations in the test sugars. As for the results obtained, some of the original and final water contents were as follows: 0·048 and 0·25; 0·307 and 2·51; 1·12 and 3·69; 0·793 and 0·158; 0·0325 and 0·60 per cent. They, therefore, varied considerably, though this rise and fall was not always observed to correspond to the fluctuations of atmospheric humidity.

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[1] *I.S.J.*, 1925, 274.

THE PETREE PROCESS AND THE CENTRAL CONSUELO (D.R.) RECORD. *Communicated to the International Sugar Journal.*

In our October issue[1] we mentioned the recent crushing record made at the Central Consuelo by the Farrel 36 in. × 84 in., 18-roller mill with single crusher, the record being 702,847 tons of cane for the 1925-26 crop from which 468,034 bags of sugar were produced. But in this reference it was not stated that the Petree process was previously installed at this factory and assisted in the results obtained. A few particulars of this installation may be of interest to our readers: two 18 ft. diam., five compartment Dorr clarifiers were used for the whole of the primary juice; and one 20 ft. diam., 5-compartment clarifier was used for the secondary juice. All the mud was returned to the bagasse in front of one mill together with the maceration fluid, and the rollers of this particular mill, and those following it, maintained their rough surface. Actually the surface of the top rollers of the mills following the application of mud to the bagasse improved during the season. The crushing season started in November, 1925, and to the date of January 31st, 1926, 215,560 tons of cane had been crushed. In the month of January 195,490 tons of cane were treated by this milling plant, the biggest week being over 27,000 tons. For 22 hours in one day over 179 tons of cane were crushed per hour. These figures were not approached in the previous season during the time the filter-presses were in use with the same crushing plant, and show convincingly that, when the milling plant is properly set for the requirements of the Petree process with rollers suitably grooved and of good gripping quality, the tonnage rate is not affected. The whole of the sugar from this heavy crushing rate was handled by 10 first, 10 second, and 6 third sugar 40 in. centrifugals, in itself a considerable achievement, this showing the free quality and low viscosity of the final products when the juices are clarified under Petree process conditions with the double defecation of the low purity low density juices. The extraction secured up to the last date mentioned was between 93 per cent. and 94 per cent. with dilution only slightly above 8 per cent. No doubt still better extraction results could have been obtained at Consuelo with a heavier dilution, but with the enormous crushing rate the evaporator capacity proved to be the limiting factor.

THE RIDDLE OF CELLULOSE. **Dr. Ebner.** *Extract from popular article published in Kölnische Zeitung (Conservative Daily Paper), April 22nd,* 1926; *also in The Living Age, June 5th,* 1926, *pages* 513-516.

"The first investigator whose patient studies gave him some insight into the special structure of the colloids and their so-called solutions was KARL VON NÄGELI whose researches into the constitution of starch in the late fifties of the last century convinced him that all colloids were made up of minute crystalloid bodies which he called micellae, or 'little crumbs.' These he assumed to be extremely diminutive groups of molecules, too small to be visible under the most powerful microscope, arranged in symmetrical patterns so that their internal structure resembled that of crystals, although they might assume various outward shapes. Nägeli's researches, however, could be pursued only to a certain point for lack of the technical instrumentalities necessary for further investigation. The next advance had to wait upon later discoveries, and only within the past few years has the nature of these molecular groups, or primary particles of the cellulose structure been fully estab-

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[1] *I.S.J.*, 1926, 557.

lished. The first step forward followed the discovery that cellulose refracted light in the same way that crystals do—for instance, the cell wax of the flax fibre produced a refraction six times that produced by quartz. It was shown further, by saturating the cellulose with water, that this double refraction was not due to the fact that the tiny rod-groups, or micellae, were embedded in a medium of different refractivity from itself, but that the micellae themselves had a distinct refractive index, such as had hitherto been assumed to be peculiar to microscopic crystals. This led to the conclusion that cellulose must consist of minute rod-like crystals connected in series, and that this stringing together of the minute rods, and the parallel grouping of the strings, persisted even throughout a great number of chemical changes itself. In 1920 ramie, an almost pure form of cellulose, was discovered to produce an X-Ray photograph of a kind previously observed only in the case of crystals. For example, while non-crystallized, or so-called amorphous, substances produce simply a black blur on a Röntgen plate, crystals and crystalline bodies produce a number of alternating bright and dark curved lines called interference lines. The appearance and strength of these lines bear an intimate relation to the inner structure of the crystal—the so-called 'crystal grating.' In the case of ramie fibres, these interference rings were not, to be sure, complete, but fell into definite symmetrically arranged points, or short segments of circles. POLANYI, who in 1921 made an exhaustive investigation of these Rontgen, four point patterns, or fibre diagrams, showed that they appear only when the innumerable tiny crystals that form a crystalline substance all lie with their axes in the same direction, instead of in different directions. Such an arrangement of these crystalloids in parallels is characteristic of the structure of all fibres—not only of ramie, but cotton, silk, wood fibre, and all similar substances of vegetable or animal origin, including hair, muscles, and nerves . . . . ."

LIMING APPARATUS, HEATERS, SETTLING TANKS AND FILTER-PRESSES IN THE P.I.
Theo. Nickelsen. *Sugar News*, 1926, 7, No. 10, 724-726.

Liming apparatus.—Where the old type of liming is in vogue, the milk-of-lime, or unslaked powder, is added directly to the tanks of juice which are agitated either by mechanical stirrers or compressed air. Stirrers are favoured over the air for several reasons; one is that, due to the large amount of air mixing with juice, there is danger of contamination; and another that, whilst the body of the juice is no doubt sufficiently agitated, the top layer of foam and scums is out of the range of agitation. A disadvantage of liming the juice in bulk is that it increases the stock of raw product in the house and the lime is not mixed as thoroughly as when the juice is limed continuously in flow. Continuous liming is practised in some of the Centrals in the P.I., and different schemes have evolved to insure cleanliness and accuracy of the procedure. Liming of the juices directly in the suction of the juice supply pumps to the heater is finding favour with the majority of centrals, but, where this is not practised, a mixing device consisting of a square vertical shaft equipped with angle iron paddles driven through bevel gears, is usually employed, where the air agitation is not favoured at this station. Liming of the juices should be made after heating and just at the point where the hot juices emerge from the heater into the pipes leading to the clarifiers. This would conform to the methods now in use of liming the cold juice at the heater juice pump. By liming after heating, the juices, due to their high temperature, would tend to mix with the lime more efficiently and there would not be the tendency for the juices passing through the heater to commence clarification action and drop part of their insoluble impurities. Lime pumps, whether piston type or centrifugal should be made of suitable metal to resist the action of the lime and should be equipped with hot water under pressure to keep the apparatus, including pipes, etc., free from caked lime. The juice-heater pumps also should be manufactured of an acid-resisting metal throughout, and where the multiple stage centrifugal pump is used, a screen over the juice supply tanks and across the end of the pump suctions of suitable mesh is essential. This screening of tanks and pumps should be carried on throughout the boiling house. *Heaters.*—A heater is now supplied of high degree of efficiency, wherein the steam is baffled in its passage amongst the tubes so that the fullest utilization of the heat is obtained, and the losses in this preliminary heating of the juices has been reduced materially. Juice heater pumps should all be provided with a pressure gauge placed in full view of the lime tank or heater operator to insure that due notice will be given, by a raising of the needle of the gauge above normal, when a blockage occurs in the pipe line, either by foreign matters or the inadvertent closing of valves in the discharge line. *Settling tanks.*—These should be lagged, and facilities for adequate cleaning should be provided. The personnel of this department should be given every facility to insure high-class operation and juice and mud valves should be located in easy access to the operator. The quantity and quality of final sugar output is largely dependent on the careful and conscientious operation of this part of the apparatus of the boiling house (in conjunction with lime treatment), and too much stress cannot be exercised in presenting to the factory executive that this department should be fundamentally correct and operations made simple and comfortable. *Filter-presses.*—Frame and plate type and bag filter-presses are in use in P.I. for the ultimate recovery of the sucrose in the residues emanating from the clarification tanks, which are first diluted, limed and re-heated in special mud re-settling tanks equipped with perforated steam coils. The liquid mud is allowed to settle and the clear juice drawn off, the balance of mud containing various impurities, including gums, bagacillo, etc., with 10 to 14 per cent. sucrose, is pumped by ram, piston or centrifugal pump, to the presses, which, after filling and forming a cake, of more or less porous character, due to the fine particles of bagasse contained, is steamed and washed with hot water until the analysis of this residue shows anywhere from 3 per cent. down to 0·5 per cent. of sucrose, according to the efficiency of the apparatus, the operator, or the constituency of the residue in question. The machinery in conjunction with this station in the boiling house department is the pumps mentioned above, including a hot water pump, and the filter cloth washing and drying machines. The pumps of the ram outside-packed type, with large metal, or ball valves, find favour with many engineers. Some prefer the single stage, medium pressure type of centrifugal pump, which is " fool-proof " in regard to clogging of valves, and operates against a set pressure without fluctuations. This type is particularly to be preferred in handling the muds to be pumped to C.I. frame type of presses, as the breakages of plates due to high pressures are reduced to a minimum. Hot water pumps should be able to give sufficient head at the press for the wash water to penetrate the cake, and the internal arrangement of the press should be such to insure the washing medium to spread and mix with all of the contained mud possible. Double pressing will accomplish this very efficiently. Steam at both juice and water inlets has been of service to reduce the sucrose content of the cake. The automatic, reversible drive, type of bag washer, belt driven from a line shaft, is in general use in the larger centrals, and a centrifugal filter-cloth drying machine, run off the same line shaft as the washer, is a help to keeping the presses supplied with clean cloths.

PRECIPITATION OF CALCIUM PHOSPHATE UNDER VARIOUS CONDITIONS. **R. G. W. Farnell.** *Journal of the Society of Chemical Industry*, 1926, **45**, No. 41, 343-347T.

Following experimental details very similar to those described in the author's previous paper on the precipitation of calcium sulphite,[1] the formation and precipitation of calcium phosphate was studied in aqueous solution, in a solution of sucrose, and in a solution containing cane colloids. The following factors were varied : (1) Time of precipitation (5-60 min.) ; (2) temperature of precipitation (20-100° C.) ; (3) extent of neutralization of phosphoric acid (reaction) (*pH* 2·2-10·6) ; and (4) initial concentration of phosphoric acid (0·007-0·0934 grms. P_2O_5 per 100 c.c.). Experimental results are represented graphically, and the following are the conclusions stated : It appears that the amount of phosphoric acid present in the cane largely affects the following characteristics of the juice : (1) Ease of clarification by lime ; (2) optimum *pH* for good clarification ; (3) buffer action ; (4) increase of acidity

[1] *I.S.J.*, 1926, 36.

on heating and settling. (1) *Ease of clarification by lime.*—A juice must contain at least 0·005—0·01 grm. P_2O_5 per 100 c.c. in order to precipitate calcium phosphate in any quantity sufficient to adsorb part of the colloidal impurities. The greater the amount of P_2O_5 naturally occurring in the juice, the more efficient is the clarification on adding lime. The "critical" P_2O_5 content of Hawaiian juice appears to be 0·03 grm. per 100 c.c., and addition of phosphoric acid to certain poor juices may subsequently become economic. SEARBY[1] has calculated that the cost of phosphoric acid sufficient to raise the P_2O_5 content of juice from 0·01 per cent. to 0·03 per cent. is about 1s. 3d. (30 cents) per ton of raw sugar manufactured. (2) *Optimum pH for good clarification.*—The higher the phosphate content of cane juice the greater is the precipitation of calcium phosphate at any given *pH*, and consequently the lower will be the *pH* at which good clarification is first secured, though a limit is set by the possibility of inversion of sucrose. If the clarified juice leaves the settling tanks at *pH* 7, or over, practically all the phosphate will have been precipitated. (3) *Buffer action.*—In many juices the phosphoric acid and phosphates comprise the chief buffer, and buffer action is proportional to the P_2O_5 content. (4) *Increase in acidity on heating and settling.*—The drop in *pH* noticed in sugar factories on heating a limed juice appears to be partly due to the precipitation of calcium phosphate, and its hydrolysis with the formation of free phosphoric acid and hydroxyapatite. There are many other factors also concerned, all of which decrease the *pH*, e.g., destruction of reducing sugar and sucrose with the formation of acids, and also the action of bacteria.

CARAMEL FORMATION IN THE PRESENCE OF NITROGENOUS SUBSTANCES. **Benno Ripp.** *Zeitsch. Verein deut. Zuckerind.*, 1926, 627-655. Solutions of levulose on being heated on the water-bath suffered loss of polarization and reducing power in direct proportion to their concentration, even at temperatures about 60° C. Caramel formed in this way had a formula identical with that of Gelis' caramelan, possessing four alcohol OH-groups, and in general behaving as a carbohydrate; but when amino-acids were present the bodies formed no longer resembled carbohydrates, though they still possessed a cupric reducing power. Caramels formed from solutions of dextrose and levulose in the presence of amino-acids owe their colour to the matter, though the depth of tint is not in direct proportion to the amount of nitrogenous substance present.[2]—CORLISS VALVE SETTING ON MILL ENGINES. **Irwin McNiece.** *Sugar News*, 1926, **7**, No. 9, 649-651. For the use of the mill engineer, a brief description of the routine of setting the valves, wrist plate, governor, and single or double eccentrics, so as to obtain the best results from the engine for particular operating conditions, is here given.—DETERMINATION OF SUCROSE BY MEANS OF THE INTERFEROMETER. **Lad. Noracek.** *Zeitsch. Zuckerind. Czecho-Slov.*, 1926, **51**, No. 4, 25-30. An interesting new method is described in which the sucrose in a solution is determined by the increase of the index of refraction resulting from the effect of the action of invertase, this increase being determined by means of the Zeiss interferometer.[3] From the results obtained with solutions containing from 1 to 13 per cent. by volume, it is seen that the error does not exceed ± 0·03 per cent. of sugar.—COMPARATIVE EXAMINATION OF ADSORPTION CARBONS ("Norit," "Supra-Norit" and "Carboraffin"). **P. Honig.**[4] *Kolloidchemische Beihefte*, 1926, **22**, No. 6-12. This is a very comprehensive series of studies reviewing the production of active carbons; reactions of carbons; the catalytic power of carbons, etc. "Norit" is pinewood carbon activated with steam at temperatures above 700° C., and "Supra-Norit" is made from the same raw material by activating it in a floating condition by means of steam and combustion gases. "Carboraffin" (as is known) is made from pinewood by impregnating it with a solution of zinc chloride and carbonizing at 500° C. A very valuable compilation of this subject for the student.

J. P. O.

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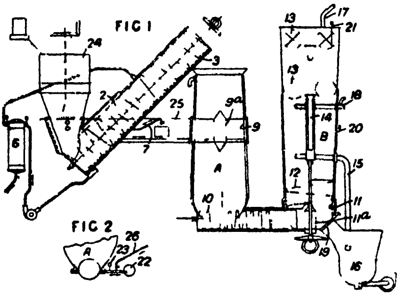
[1] Proc. Forty-third Annual Meeting of the Hawaiian Sugar Planters' Association, 1924, 57.
[2] On this subject see also *I.S.J.*, 1914, 184, 230; 1918, 43; 1919, 139; 1926, 171, 281.
[3] A particularly accurate type of interferometer is made by the firm of Adam Hilger, Ltd., London.
[4] Chemist, General Norit Co., Amsterdam.

Review of Recent Patents.[1]

UNITED KINGDOM.

EXTRACTION OF SUGAR JUICE BY DIFFUSION.* **C. Camuset,** of Bretigny-sur-Orge, Seine-et-Oise, France. 258,849. September 2nd, 1926; convention date, September 25th, 1925.

In a diffusion plant for extracting sugar form beet, etc., in which the liquid and the extractable materials are circulated continuously in the opposite directions, separate heaters are provided to maintain the extraction liquid at a predetermined temperature at different parts of the apparatus. In the extraction of cut beet, for example, the slices pass in succession through preliminary heating and extraction apparatus 1, 3 and two diffusion vessels *A*, *B*. Material drops from a cutter 24 into a hopper 1 which is filled with liquid from the vessel *A* up to a predetermined level 25, and is fed by screw 2 through a vessel 3 having a perforated double bottom which drains off the liquid to the first diffuser *A*. Liquid is circulated from apparatus 1, 3 by a centrifugal pump through a heater 6. The material is withdrawn from the vessel *A*, which has inclined sides to facilitate downward movement of the material, by a perforated screw or other conveyor 10 which is rotatable at different speeds and forces the solids into the second diffuser *B*. This latter is tapered downwards and the material is fed upwards therethrough with the aid of a perforated screw or other conveyor 12 and the exhausted material withdrawn through a central telescopic tube 14 and pipe 15. A vertically moveable stirring device 13 assists removal of the material which is then mixed with water in apparatus 16 and pumped to extraction presses. Liquid from the presses, at a temperature of about 30-40° C., is supplied together with fresh water at a temperature of about 45° C. through pipe 17 to the second diffuser *B*, the press liquid being added either at the top of the diffuser with the fresh water or at other heights, for example through the perforated tube 18. Liquid passes from diffuser *B* through a perforated surface 11 to a heater 22, Fig. 2, and thence to diffuser *A*, an antiseptic, such as bisulphite of soda, being added if desired through pipe 26. A second perforated surface 11*a* may also be provided for withdrawal of the liquid from diffuser *B*. Liquid passes out from diffuser *A* through perforations 9 in the walls to the vessel 3. A centrally disposed perforated removal device 9*a* may also be provided. Liquid is finally withdrawn from the hopper 1 through the pipe 7. Operation is arranged so that the solids and liquid in diffuser *B* have substantially the same density. The level of the liquid on diffuser *B* is kept at such a level as to set up a pressure which forces the liquid through the diffusers in opposition to the movement of the solids. Diffuser *B* has an exhaust valve 19, and thermometers 20, 21 and 23 are provided.



PRODUCTION, APPLICATION AND REVIVIFICATION OF DECOLORIZING CARBONS. (*A*) **J. Nagtegaal,** of Coevorden, Holland. 257,766. October 14th, 1925. (*B*) **Soc. pour l'Exploitation des Procédés E. Urbain,** of Paris. 257,917. August 24th, 1926; convention date, September 4th, 1925.

(*A*) In the production of active carbon by the dry distillation of carbonaceous material in a retort set in a furnace, the distillation gases are withdrawn and introduced into the furnace, whence after being burned they are passed into the retort through apertures in the wall thereof in order to activate the carbonized product.

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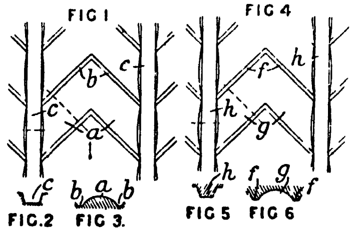
[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D C (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin, Germany.

Preferably a plurity of retorts are placed in common furnace, so that while the carbonization stage is proceeding in one or more retorts, the activation is taking place in the remainder. Besides having the usual feed and discharge openings the retorts may be connected with a pump, the discharge pipe of which opens into the furnace. (*B*) Carbon is produced as a non-volatile residue in the manufacture of phosphorus or phosphoric acid from mono-calcium phosphate by reduction at high temperature with carbon or the char produced by calcining peat, wood, animal matter and similar organic substances. Preferably, the raw materials are used in the granular state in order to facilitate the removal of the gases produced, and larger quantities of carbon or carbonaceous materials are used than when phosphorus only is obtained. The less carbon, etc. is used however, the more active is the product, which can be rendered still more active by extracting the tricalcium phosphate present with acid. The phosphorus may be burned to form phosphoric acid. In place of monocalcium phosphate, phosphoric acid itself may be used. Specification 257,269 is referred to.

CO-ACTING ROLLERS FOR CANE CRUSHING.* **Hugh W. Aitken,** of Britannic House, Park Circus, Glasgow. 255,787. April 27th, 1926.

Thoroughly breaking the cane, squeezing it between the surface of the rollers, so as to press out as much as possible of the juice, and providing channels or the like for the escape of the expressed juice on the feed side of the co-acting rollers are desiderata all three which have not hitherto been provided for in the same one pair of co-acting rollers, but are obtained in the present invention. Claim is made for "co-acting rollers for the crushing of sugar cane having intermeshing ridged and furrowed surfaces and channels or the like for the escape of the expressed juice, characterized by the fact that channels are provided on the surface of one or both rollers, these channels being at right angles to the axis of the rollers, and that the other or both rollers is or are furnished with projecting bands which enter and roll within the said channels, filling or almost filling the same." The ridges of the one roller fill or almost fill the furrows of hollows of the other roller so that unsqueezed cane cannot pass through between the two rollers. As shown in the drawing, the lower roller has zig-zag ridges *a*, Figs. 1 and 3, of rounded or arched section, and channels *c*, Fig. 2, are formed at right-angles to the axis at every other plane of division between the sections of ridges. The upper roller has ridges *f*, Figs. 4 and 6, separating rounded hollows or furrows *g*, and projecting bands *h*, Fig. 5, which are arranged at right-angles to the axis and enter the channels *c* in the lower roll. The ridges *f* and furrows *g* of the upper roller conform in section to the furrows *b* and ridges *a* respectively of the lower roller; while the channels may be cut in the roller at each plane of division between the sections of ridges. Channels and bands may be provided in and on both rollers, the bands on either roller entering the channels on the other. The ridges may be at an angle of 45° to the axis of the roller.



UNITED STATES.

CENTRIFUGAL BASKET. **Eugene Roberts** (assignor to the **Western States Machine Co.,** of Salt Lake City, Utah). 1,581,089. April 13th, 1926.

A filter construction for the basket wall is provided so arranged and dimensioned as to afford practically complete drainage for the entire area of the sugar-sustaining basket wall instead of affording drainage merely for only a small portion of said area as heretofore, thereby materially abbreviating both the duration of the juice-separating operation and that of the washing operation besides decreasing materially the quantity of water required and the consequent waste of sugar carried off in solution thereby, as well as greatly improving the quality or cleanness of the sugar so treated. A further improvement relates to that type of centrifugal basket known as a self-discharging basket in which the bottom of the basket, of frustro-conical form, has a shaft-connecting spider in its reduced open bottom and an attaching ring or flange at its top for connexion with and support of the cylindrical wall of the basket. In this type of machine there is of necessity an annular area of considerable extent that is normally closed against percolation of the liquid by reason of the fact that the attaching ring, the sub-tending part of the basket, and the outer reinforcing band, form a solid annular wall preventing any effective drainage so that the opposed section of the sugar wall is very imperfectly treated both as to extraction of the juice and as to washing of the sugar grains. This difficulty is overcome by providing this attaching rim or flange of the basket bottom with adequate drainage passages which are covered by a sieve-like screen or strainer so supported as to resist the powerful outward thrust of the sugar and yet allow the liquids to flow freely into the drainage passages without material obstruction. A filter construction is in this way provided for a centrifugal basket in which the entire sugar-sustaining area of the basket wall is effectively drained without leaving considerable areas practically devoid of drainage facilities. Claim 1 reads : A filtering construction for a centrifugal basket embracing in combination with a surrounding basket wall formed with discharge perforations well spaced apart, an interiorly disposed fine foraminous filter screen, an intermediately disposed relatively stiff bridge plate having closely arranged coarse perforations while providing substantially level support at intervals to sustain the screen against outward bulging under pressure, and spacing means affording at intervals exterior supporting engagement with the bridge plate to form drainage spaces on the interior of the basket wall directly tributary to discharge perforations in the basket wall. Claim 9 reads : A bottom for a centrifugal basket embracing a funnel-shaped perforated member having upper and lower attaching flanges for connexion respectively with a peripheral basket and with an interior supporting spider, interiorly projecting ledges forming drainage passages leading to liquid discharge openings, a rigid closely-perforated frustro-conical bridge member interiorly supported upon said ledges, and a frustro-conical filter screen of finely perforated thin metal supported on said bridge plate against outward bulging under pressure.

CONTINUOUS DIFFUSION APPARATUS FOR EXTRACTION FROM BEETS, ETC.[1] **Walter Raabe,** of Cothen, Anhalt, Germany. 1,575,936. March 9th, 1926.

CANE CAR. **Robert Fricke** (assignor to **Ernest W. Greene and William G. Hall,** of Honolulu, T.H.). (*A*) 1,583,873 ; (*B*) 1,583,874. May 11th, 1926.

(*A*) This invention has for its object to provide for a car of the platform type having end walls with longitudinal flexible connexions between the upper corners of the end walls, each connexion being provided with a releasable coupling intermediate its length, and pendant flexible connexions between the longitudinal connexions and the platform, said pendant connexions being spaced at intervals and preferably detachably connected to the platform, said longitudinal and pendant connexions constituting the load retaining means at the sides of the platform car, which facilitate the unloading of the car by releasing the couplings in the longitudinal connexions and permitting both the longitudinal and pendant connexions to collapse toward the end of the car, thereby leaving the entire side of the car open, so that the load may be readily discharged. (*B*) And this one provides a car of the platform type having end walls and completely open sides with flexible longitudinal members extending between and around the upper portions of the end walls and preferably constituting a flexible band having releasable couplings adjacent the end walls, which band is supported in its adjusted position by guide studs on the end walls, the longitudinal reaches or sections of the band extending along the sides of the car being connected at intervals by pendant flexible loops, the lower portions of which engage the platform of the car and are preferably anchored thereto by pins, so as to retain the loops in proper relation when the car is being loaded.

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[1] See U.K. Patent, 228,948 ; *I.S.J.*, 1926, 170.

DRYING BAGASSE BY MEANS OF FURNACE FLUE GASES. **William Kajerdt and Mariano J. Galainena,** both of Havana, Cuba. 1,589,805. June 22nd, 1926.

Bagasse from the mills is dropped upon an endless chain conveyor which carries it to the opening of a hopper, the outlet from which is controlled by a counterweighted trap entering the suction conduit of a blower. Hot gases are drawn by means of the blower from the furnaces (suitable thermo-static means being provided for the control of the temperature), and passed into an apparatus for separating the bagasse from the heated gases, the former being finally sent through a separate connexion for delivery to the furnaces. Claim is made for : An apparatus for drying bagasse and similar materials the combination, with a blower and means for driving the same, of means for supplying heated gases to said blower, thermostatic means for controlling the temperature of said gases, means for delivering bagasse to the intake of the blower, a discharge conduit from the blower through which said bagasse may be driven by the current of heated gases also delivered by the blower, an apparatus for separating said bagasse from said heated gases, and mechanism for discharging the dried bagasse from said separating apparatus.

PROCESS FOR THE PRODUCTION OF ALDOLS FROM FORMALDEHYDE. **Clarence J. Herrly** (assignor to **Carbide and Carbon Chemicals Corporation,** of New York). 1,598,522. August 31st, 1926. A process of making an aldol from an aliphatic aldehyde containing a plurality of carbon atoms in its molecule, comprises adding to the substantially neutral formaldehyde between about 0·01 per cent. and 0·10 per cent. by weight of caustic alkali, and permitting a reaction temperature in material excess of 20° C. for a suitable period.—BEET TOPPING MACHINE. **Christian J. Jensen,** of Preston, Idaho. 1,598,527. August 31st, 1926. Claim 1 : A beet topper comprising a main frame, an auxiliary frame pivoted at its front end to said main frame and having a transverse guideway at its rear end, a blade-carrying frame disposed vertically and mounted on said guideway for both reciprocatory and swinging movements, a transverse beet topping blade carried by the lower portion of said blade-carrying frame, means for reciprocating the latter and draft links pivoted to said auxiliary frame and to the lower portion of said blade-carrying frame. Claim 6 : A beet topper comprising a main frame having a transverse driven shaft, an auxiliary frame under said main frame having final topping means at its rear end, bars projecting downwardly from the main frame, means pivoting the front end of the auxiliary frame to said bars on an axis below said shaft, upper and lower transverse bars extending between the aforesaid bars and secured thereto, said transverse bars having central bearings, a vertical shaft rotatably mounted in said bearings, driving means connecting said vertical shaft with the above-named transverse shaft, and an initial topping knife carried by the lower end of said vertical shaft.—REFINING ALCOHOL. **Emile A. Barbet,** of Paris, France. 1,598,548. August 31st, 1926. A process for the production of absolute alcohol which comprises treating a mixture of alcohol and water with a dehydrating agent, distilling off a portion of the alcohol from the mixture, diluting the residual portion, resulting from said distillation, with water and distilling the diluted residual portion so as to obtain a distillate of aqueous alcohol for the said dehydrating step.—DESACCHARIFICATION OF MOLASSES, ETC., USING BARIUM COMPOUNDS. **Camille Deguide,** of Enghien, France. 1,579,090. March 30th, 1926. Previous to the recovery of the sucrose in cane molasses in known manner, the impurities are precipitated and destroyed (in particular, reducing sugars and " gums ") by monobarytic silicate ($SiO_2.BaO$) or the silicate intermediate between the mono and bibarytic silicates ($2SiO_2.3BaO$).—EVAPORATOR FOR CANE SYRUP. **Samuel W. Barnes,** of Barnum, Texas. 1,598,670. September 7th, 1926. An evaporator comprising a pan, a longitudinally extending partition dividing the pan into chambers of different widths, said partition having a passage beneath one end thereof forming communication between the chambers, an inclined wall at that end of the smaller chamber remote from the passage in the partition, having its upper extremity terminating below the upper edge of the chamber, a discharge spout in that end of the larger chamber remote from the passage, and spaced baffles on the bottom of the larger chamber.

Sugar Crops of the World.

(Willett & Gray's Estimates to November 18th, 1926.)

	Harvesting Period.	1926-27. Tons.	1925-26. Tons.	1924-25. Tons.
United States—Louisiana	Oct.-Jan.	88,000	124,447	79,002
Texas	,, ,,	—	—	—
Porto Rico	Jan.-June	530,000	544,484	589,760
Hawaiian Islands	Nov.-June	714,000	705,350	692,804
West Indies—Virgin Islands	Jan.-June	6,000	5,664	7,200
Cuba	Dec.-June	4,500,000	4,884,658	5,125,970
British West Indies—Trinidad	Jan -June	70,000	73,561	69,628
Barbados	,, ,,	50,000	47,535	49,315
Jamaica	,, ,,	50,000	57,675	42,843
Antigua	Feb.-July	14,000	12,800	17,300
St. Kitts	Feb.-Aug.	14,000	16,380	15,563
Other British West Indies	Jan.-June	6,000	7,500	6,253
French West Indies—Martinique	Jan.-July	45,000	48,121	47,995
Guadeloupe	,, ,,	35,000	32,998	39,990
San Domingo	Jan.-June	335,000	354,720	311,270
Haiti	Dec.-June	12,500	11,249	8,280
Mexico	,, ,,	175,000	190,282	165,223
Central America—Guatemala	Jan.-June	33,000	25,151	25,562
Other Central America	,, ,,	70,000	62,500	73,240
South America—				
Demerara	Oct.-Dec. and May-June	95,000	107,580	90,874
Surinam	Oct. Jan.	13,000	10,000	10,200
Venezuela	Oct.-June	19,000	19,000	20,625
Ecuador	Oct.-Feb.	18,000	16,976	18,700
Peru	Jan.-Dec.	275,000	265,000	310,522
Argentina	May-Nov.	440,000	395,733	246,717
Brazil	Oct.-Feb.	700,000	650,000	812,493
Total in America		8,807,500	8,669,364	8,877,329
Asia—British India	Dec.-May	3,000,000	2,923,000	2,548,000
Java	May-Nov.	1,970,000	2,278,900	1,977,490
Formosa and Japan	Nov.-June	450,000	498,460	458,836
Philippine Islands	,, ,,	520,000	436,000	581,064
Total in Asia		5,940,000	6,136,360	5,565,390
Australia	June-Nov.	425,000	522,344	
Fiji Islands	,, ,,	85,000	90,000	
Total in Australia and Polynesia		510,000	612,344	536,490
Africa—Egypt	Jan.-June	90,000	95,000	79,918
Mauritius	Aug -Jan.	195,000	241,220	224,710
Réunion	,, ,,	50,000	59,015	52,380
Natal	May-Oct.	217,000	214,152	143,974
Mozambique	,, ,,	65,000	70,000	44,278
Total in Africa		617,000	679,387	545,260
Europe—Spain	Dec.-June	7,500	9,000	8,087
Total cane sugar crops		15,882,000	16,106,455	15,532,556
Europe—Beet sugar crops		7,111,000	7,423,073	7,079,589
United States—Beet sugar crop	July-Jan.	840,000	804,439	974,185
Canada—Beet sugar crop	Oct.-Dec.	30,000	32,475	36,200
Total beet sugar crops		7,981,000	8,259,987	8,089,974
Grand total Cane and Beet Sugar	Tons	**23,863,000**	**24,366,442**	**23,622,530**
Estimated decrease in the world's production	,,	1,003,442	*743,912	*3,506,421

* Increase.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1926. Tons.		1925. Tons.
Total Receipts, January 1st to November 24th	3,156,522	..	3,083,658
Deliveries ,, ,, ...	3,019,069	..	3,055,931
Meltings by Refiners ,, ,, ...	2,985,000	..	6,036,380
Exports of Refined ,, ,, ...	74,000	..	265,000
Importers' Stocks, November 24th	146,109	..	27,727
Total Stocks, November 24th	223,456	..	57,085
	1925.		1924.
Total Consumption for twelve months	5,510,060	..	4,854,479

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924 Tons.		1925 Tons		1926 Tons.
Exports	3,736,359	..	4,399,231	..	4,110,196
Stocks	145,422	..	460,709	..	390,989
	3,881,781		4,859,940		4,501,185
Local Consumption	115,000	..	120,000	..	130,000
Receipts at Ports to October 31st	3,996,781		4,979,940		4,631,185

Havana, October 31st, 1926.

J. GUMA.—L MEJER

Beet Crops of Europe.

(Licht's Estimates at December 2nd, 1926.)

	Harvesting Period.	1926-27. Tons.	1925-26. Tons.	1924-25. Tons.
Germany	Sept.-Jan.	1,675,000	1,595,000	1,575,684
Czecho-Slovakia	Sept.-Jan.	1,050,000	1,488,000	1,409,703
Austria	Sept.-Jan.	78,000	78,000	75,000
Hungary	Sept.-Jan.	185,000	166,000	202,354
France	Sept.-Jan.	690,000	747,000	827,472
Belgium	Sept.-Jan.	240,000	332,000	400,105
Holland	Sept.-Jan.	300,000	307,000	329,244
Denmark	Sept.-Jan.	150,000	182,000	140,000
Sweden	Sept.-Dec.	25,000	205,000	135,000
Poland	Sept.-Jan.	575,000	589,000	494,854
Italy	Aug.-Oct.	310,000	182,000	422,000
Spain	Sept.-Jan.	290,000	250,000	260,000
Other Countries	Sept.-Jan.	440,000	300,000	348,000
Total, excluding Russia		6,008,000	6,421,000	6,619,416
Russia (Ukraine, etc.)	Sept.-Jan.	975,000	1,050,000	458,375
Total in Europe		6,983,000	7,471,000	7,077,791

United Kingdom Monthly Sugar Report.

Our last report was dated the 11th November, 1926.

Throughout the period under review the market has undergone a complete change. Sugar has been firm and active and an advance of 2s. to 2s. 6d. per cwt. has been established, both in raws and refined.

The London Terminal Market has been very active and the registrations for November are the largest ever recorded in the London market either before or after the war. On one particular day the registrations were over 50,000 tons. Only small quantities were tendered in fulfilment of November contracts, but an enormous business has been transacted in December from 15s. 6¾d. to 18s. to 17s. 2¼d. to 17s. 9¾d. to 17s. 4½d. to 18s. 1½d. So far about 25,000 tons have been tendered in fulfilment of December contracts, but these were readily taken up and had no depressing effect on the market. Speculation is becoming much more interested in the article and buying orders from various countries have all helped to stimulate the position. March was traded in from 16s. 3d. to 18s. 6¾d. to 17s. 9d. to 18s. 5¼d. to 18s. 3d. to 18s. 7½d., May sold from 16s. 6d. to 18s. 9¾d. to 18s. to 18s. 6¾d. to 18s. 3d. to 18s. 9¾d., August sold from 16s. 9¾d. to 18s. 9¾d. to 18s. 1½d. to 18s. 6d. to 18s. 3d. to 18s. 10½d. A fair business has been put through in October/December, October generally commanding a premium of 3d. per cwt. over December. The latest prices are December 18s. 0¾d., March 18s. 6¾d., May 18s. 9d., August 18s. 9¾d., and December (1927) 17s. 5¼d.

Trading in actual sugars has been in good volume, and sentiment having changed the trade have bought rather freely. Ready sugar has not been plentiful and—owing to the high price of British Refined—has been in good demand. The price for Czecho Granulated has risen from 16s. 4½d. to 18s. 6d., and Dutch from 16s. 7½d. to 18s. 9d. Czecho Granulated for January/March has been sold up to 18s. 9d., and Dutch up to 19s. 3d. Granulated for March/August sold up to 19s. 3d. Spot sugars have enhanced in value and the London stock has been greatly reduced. Dutch Granulated sold from 29s. to 31s. 7½d. duty paid. Home Grown Sugars have found a ready market at advancing prices and various factories sold from 30s. to 32s. 3d. The latest prices are 32s. to 32s. 6d. according to factory. It is estimated that 60 per cent. of the production has already been sold.

The British refiners made several alterations during the month. On November 18th the prices were advanced 3d. per cwt., and the Empire Granulated was withdrawn, on November 19th they raised their prices by 1s. 6d. per cwt., on November 22nd by 3d., and again on November 24th by 6d., making a total advance of 2s. 6d. per cwt. Their latest prices are No. 1 Cubes 37s. 6d., London Granulated 33s. 4½d.

In spite of the fact that one refinery in London still remains closed a large business has been done in raws. Cubans have been sold from 13s. 9d. to 15s. 9d. c.i.f. The latest price is 16s. 1½d. Small parcels of Brazils and Perus have been sold from 13s. 7½d. to 15s. 7½d. The value of Mauritius is 21s. 6d. In New York a large business has been done in raws from 2¾ to 3⅜ cents, at which price there are buyers to-day. Several cargoes have been sold to the East, and also Canada.

The Futures market is about 40 to 50 points higher than a month ago.

F. O. Licht has issued another estimate for Europe, viz., 6,983,000 tons, which shows a reduction of 487,000 tons on last year. The largest reduction is in Czecho-Slovakia, which crop he places at 1,050,000 tons against 1,488,000 tons last year.

The total stocks in Cuba are now about 20,000 tons less than last year, and the stocks at the ports are 195,000 tons against 255,000 tons last year.

Considerable excitement has been caused by rumours of the Cuban crop restrictions. Originally the President decreed that the grinding should not start before the 1st January. Since then it has been authoritatively stated that he will sign a decree limiting the crop to 4,500,000 tons. So far this figure is not a *fait accompli*, but it is generally accepted that within the next few weeks this decree will be signed. In the meantine the Cuban President has called for a world conference of producers to prevent over-production.

Messrs. Willett & Gray have further reduced their estimate for the production of the world to 23,150,000 tons which shows a reduction on last year of 1,200,000 tons.

21, Mincing Lane,
London, E.C. 3.
8th December, 1926.

Arthur B. Hodge,
Sugar Merchant and Broker.

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(Am. Comm. Report) *American Commerce Report.*]

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